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#### 21st Annual Session AMERICAN CONGRESS OF PHYSICAL THERAPY

SEPTEMBER 9, 10, 11, 12, 1942

HOTEL WILLIAM PENN

PITTSBURGH, PA.

Volume XXIII

MARCH, 1942

No. 3

# 21st Annual Scientific and Clinical Session

## AMERICAN CONGRESS of PHYSICAL THERAPY

September 9, 10, 11, 12, 1942

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## AMERICAN CONGRESS of PHYSICAL THERAPY

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Volume XXIII

No. 3

## ARCHIVES OF PHYSICAL THERAPY

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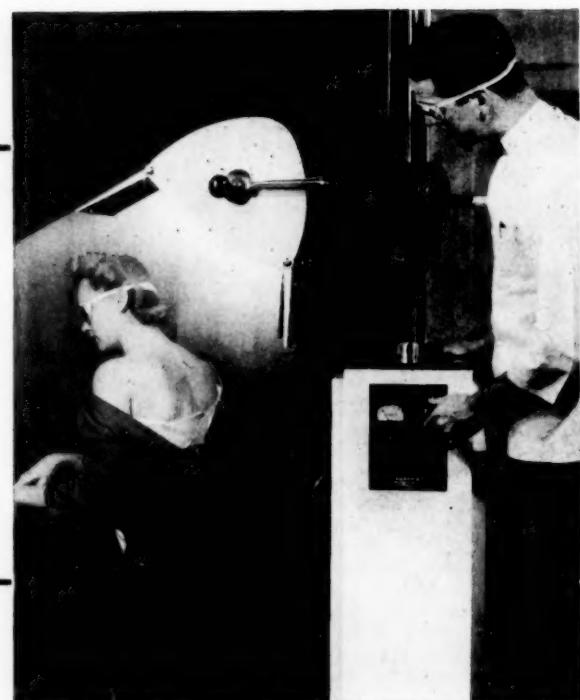
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## LIGHT THERAPY IN DERMATOLOGY \*

ANTHONY C. CIPOLLARO, M.D.

NEW YORK, N. Y.

The term light therapy refers to the use of ultraviolet rays, infra-red rays and rays emitted from some light source through colored glass (blue, green, violet, red, orange, etc.). The most commonly used form of light in the treatment of cutaneous diseases is ultraviolet. Colored lights are advocated by some dermatologists but have been found to be useless in practice except for the possible psychologic effect that their use may have. Infra-red radiation is used to a limited extent in the treatment of a few dermatoses. The source of heat is generally a hot poultice, hot wet dressings or hot baths. Some dermatologists employ infra-red radiators in the treatment of a few dermatoses and infections.

Ultraviolet radiations both from natural and from artificial sources are positively valuable in the treatment of many cutaneous diseases. However, there is some difference of opinion regarding the particular regions of the light spectrum that produce beneficial effects. Differences of opinion exist concerning which dermatoses and what stages of certain dermatoses are definitely cured or improved as a result of exposure to ultraviolet rays.

The subject of this paper has been repeatedly discussed by many physicians. Reiteration and repetition will serve to refresh one's memory and again bring attention to the fact that ultraviolet rays are extremely valuable in the armamentarium of the dermatologist. When ultraviolet rays are properly used, satisfactory results are often obtained, but when they are improperly used, not only does discouragement and disappointment result but in some cases harm may be done. It is well for every physician who uses this form of radiant energy to be familiar especially with the limitations and with the contraindications of light. In the past practically every dermatosis was subjected to ultraviolet irradiation, but now it is definitely known that it is not only useless but dangerous to irradiate some dermatoses. It is impossible with the methods now available to evaluate critically the degree of improvement following treatment with any agent. Evaluation of the effects is based on impressions and clinical observations.

The physiologic effects of radiation as they are now understood fail to reveal why certain dermatoses involute under the influence of irradiation and others do not or why in certain stages a particular disease improves and in other stages the same agent and the same doses may accentuate it and make it worse. Therefore it is essential for the physician who employs ultraviolet radiation to be familiar with the physical and chemical characteristics of the rays and with their physiologic and biologic effects as well as with the natural involution and evolution of the disease under treatment. It is also difficult to understand whether the changes brought about in a particular dermatosis after exposure to ultraviolet rays are due to the chemical changes occurring in the skin or to systemic changes after absorption of the radiations. Recently apparatus have been devised which employ the bactericidal effects of ultraviolet rays. Such radiations should be particularly effective on pyogenic dermatoses. Evidence is rapidly accumulating to show that short wave ultraviolet rays are therapeutically valuable and prophylactic

\* From the Skin and Cancer Unit of the New York Post-Graduate Medical School, Columbia University, Dr. George M. Mackee, Director.

\* Read at the Twentieth Annual Session of the American Congress of Physical Therapy, Washington, D. C., September 5, 1941.

against infection with pyogenic organisms. Their value to prevent fungous infections has not been definitely established as yet.

#### Artificial Sources of Ultraviolet Rays

The three types of lamps most commonly used are the hot quartz mercury arc lamp, the carbon arc lamp and the low pressure quartz mercury vapor lamp of the cold quartz type. Many other types of lamps are used, but the three enumerated are those that are most frequently found in the offices of dermatologists and at dermatologic centers.

Dermatologists who advocate the use of carbon arc lamps justify their use on the basis that the initial expense of such lamps is low, that the results of treatment are satisfactory and that the ultraviolet ray spectrum approximates that of the sun. They also state that by varying the carbon and the filters, the desired wavelength may be obtained. The infra-red rays emitted from carbon arc lamps may add to the efficacy of the ultraviolet rays in the treatment of some dermatoses.

The so-called hot quartz mercury arc lamps are preferred by some dermatologists because they emit less heat than carbon arc lamps and therefore may be placed closer to the skin, which permits shortening the time of the exposure. For years this type of ultraviolet ray generator has been most commonly used by dermatologists. Recently, however, many dermatologists have shifted to the low pressure mercury vapor lamp of the cold quartz type. The popularity of this lamp among dermatologists is probably due to the following factors:

1. The lamp can be placed close to the skin, which permits shortening the time of exposure.
2. General irradiation of the body may be accomplished quickly because the lamp can be held in the hand and passed over the entire surface of the body.
3. With large doses there are less erythema, no blistering (with rare exceptions), less discomfort and greater desquamation.
4. There is no loss of time, because the lamp begins to operate at its maximum intensity within a few seconds after it is turned on.
5. It is bactericidal.
6. When exfoliation is the desired feature, as in postacne scarring and in pityriasis rosea, it may be obtained with little discomfort.

These enumerated features may act as an advantage in the treatment of certain dermatoses and as a disadvantage in the treatment of others.

In recommending a single ultraviolet ray generator to a dermatologist, one is often puzzled as to what is the best advice. With regard to cutaneous diseases, it is safe to say that the effect is much the same with solar radiation, the hot quartz mercury arc, the carbon arc and the cold quartz lamp provided each is properly used. This statement is general and does not apply to every cutaneous disease nor to every type of generator. When ultraviolet rays are extensively used it is well to have more than one type of generator.

#### Practical Applications of Ultraviolet Rays

The statement has often been made that good results are obtained with ultraviolet radiation in treating most cutaneous diseases. This claim, of course, is erroneous and is probably based on the clinical impressions of physicians who have little if any knowledge of dermatology. The disease may have involuted spontaneously, there may have been a faulty diagnosis or the condition may have improved as a result of treatment with topical

remedies. However, ultraviolet irradiation is of great value in the practice of dermatology. There are about 35 dermatoses in which alleged good results have been obtained by at least several prominent dermatologists or by physicians who are experts in the therapeutic use of light. These diseases are as follows:

Acne group	Nevus flammeus (portwine mark)
1. Acne conglobata (acne cacheticorum)	Parapsoriasis
2. Acne varioliformis	Pityriasis rosea
3. Acne vulgaris	Pruritus group
Adenoma sebaceum	1. Essential pruritus
Alopecia areata and prematura	2. Pruritus ani
Dermatitis herpetiformis	3. Pruritus vulvae
Dermatophytosis and dermatophytide	4. Senile pruritus
Eczema group	Psoriasis
1. Eczema hemostaticum	Sycosis vulgaris
2. Eczema seborrhocicum	Telangiectasis and nevus araneus
3. Eczema venenatum	Tuberculodermas
4. Infantile eczema	1. Lupus vulgaris
5. Infectious eczematoid dermatitis	2. Scrofuloderma
6. Intertrigo	3. Tuberculosis cutis orificialis
7. Neurodermatitis	4. Tuberculosis verrucosa cutis
Erysipelas	5. Erythema induratum of Bazin
Furunculosis and folliculitis	6. Papulonecrotic tuberculide
Leukoderma and vitiligo	Ulcers and wounds

To do justice to this subject a monograph is required. For present needs only a short description of the dermatoses and the technic of treatment will be given.

*Acne Conglobata.* — This form of acne is fortunately rare. It is extensive, often affecting the entire face, chest and back. The lesions are either cystic, indurated or of the deep pustular type. When the lesions involute they leave disfiguring and deep-pitted scars. Acne conglobata responds best to roentgen therapy, but where this is not available long-continued treatment with generalized ultraviolet irradiation keeps the condition under control and gives a permanent cure in some cases.

*Acne Varioliformis.* — Good results are obtained in the treatment of this condition when localized ultraviolet irradiation is combined with the use of antiseptic topical remedies.

*Acne Vulgaris.* — Acne vulgaris is extremely common and most distressing to those who possess it. When ultraviolet radiation is used together with the proper choice of topical remedies, adequate instruction and advice regarding diet, habits and the removal of infectious foci and other disturbances and the correction of secondary anemia, the majority of the patients respond. The mere application of ultraviolet rays does no good unless it is combined with proper local and systemic treatment. Mild erythema doses of ultraviolet radiations are applied two or three times a week to the affected areas. It is not necessary to give such intense exposures as to produce blistering. In many cases of acne vulgaris, especially those in which there are numerous comedones, the response is better when ultraviolet radiations from a cold quartz lamp are used. It is essential in some cases of extensive acne vulgaris to administer suberythema doses of ultraviolet rays to the entire body as well as more intensive treatment to the affected areas. It is always well to emphasize the fact to the patient that when an acne lesion is of sufficient depth a prominent pit or scar may result. Such prominent disfigurement is due not to the treatment administered but to the nature of the disease. This statement applies whether lotions, ultraviolet rays, roentgen rays or grenz rays are used.

*Adenoma Sebaceum.* — This rare dermatosis generally occurs on the face and may be quite disfiguring. Probably the best way to handle the lesions is by using light electrode desiccation or electrocoagulation. When the lesions are numerous and confined to a small area they may all be treated at the same time by intensive irradiation with the cold quartz lamp or with blistering doses from the Kromayer lamp.

*Alopecia.* — Alopecia may be divided into two groups, i. e. alopecia areata and alopecia prematura. Alopecia areata comprises the localized and universal types, whereas alopecia prematura comprises the seborrheic, idiopathic and hereditary types. All these forms of alopecia have been treated at one time or another with ultraviolet rays, and there is a great difference of opinion as to the beneficial effects to be derived by exposure of the affected areas to the various sources of these rays. Mildly erythematous doses are a useful adjuvant to the treatment in some cases of alopecia prematura and of alopecia areata. It must be clearly understood, however, that ultraviolet irradiation does not restore or grow hair.

*Dermatitis Herpetiformis.* — This condition is chronic, pruritic and characterized by grouped vesicular lesions which after involution leave pigmentary areas. The pruritus accompanying this condition is often difficult to control by any method of treatment. Ultraviolet irradiation often relieves the intense pruritus. The treatments should be given daily and in doses insufficient to provoke an erythema.

*Dermatophytosis.* — Dermatophytosis is an eczematous eruption caused by fungi. It occurs most commonly on the feet and has been popularly termed "athlete's foot." There are three varieties — the interdigital, the vesicular and the keratotic. When the fungous infection occurs in the axillas, in the umbilicus, under pendulous breasts and on other parts of the body, the term eczema marginatum is used. When dermatophytosis occurs on the hands it must be differentiated from dermatitis venenata. The term dermatophytide simply indicates an allergic manifestation to the fungus and consists of scaly or vesicular lesions on any part of the body. The most common form of dermatophytide is a vesicular eruption on the hands, secondary to an active fungous infection of the feet.

Practically all entities included under the terms dermatophytosis and dermatophytide yield best when treated with roentgen rays or appropriate topical remedies. When ultraviolet radiation is used as an adjuvant to topical remedies, the fungous infection seems to respond better. Ultraviolet rays alone have little or no effect on fungous infections. As in all eczematous eruptions, ultraviolet rays are not to be used in the presence of acute, vesicular and exudative eruptions. Beneficial effects of ultraviolet irradiation are noted especially when the chronic and scaly patches of dermatophytosis and dermatophytide are treated with small and often repeated doses of ultraviolet rays.

*Eczema.* — The term eczema signifies an inflammation of the skin (dermatitis). Today eczema is divided into clinical types, each type having a different cause and exhibiting fairly definite characteristics. The therapeutic indications are different for the various types of eczema. The diseases included in this group are eczema hemostaticum, eczema seborrhoicum, eczema venenatum, infantile eczema, infectious eczematoid dermatitis, intertrigo and neurodermatitis.

*Eczema Hemostaticum.* — This condition occurs generally on the legs of elderly persons and is due primarily to impaired circulation. Occasionally ulcers occur in this condition. Ultraviolet rays in moderate doses seem to be beneficial, especially if ulcers are present.

*Eczema Seborrhoicum.* — This condition is presumably caused by a microorganism and occurs most commonly in the nasolabial folds, on the forehead, on the scalp, on the sternum and in the interscapular region. The intertriginous areas may also be involved. The scalp is usually covered with dandruff. Occasionally the eruption is generalized. Ultraviolet irradiation appears to give good results, especially when erythema doses are used for the chronic dry patches. For the nonexuding generalized type of dermatitis seborrhoicum, suberythema doses of ultraviolet rays given daily to the entire body are beneficial. The best results naturally are obtained when appropriate topical remedies, systemic treatment and ultraviolet radiation are used simultaneously.

*Eczema Venenatum.* — Eczema venenatum (dermatitis venenata) is caused by external contact with a substance to which the patient has become sensitized. Well known examples are ivy dermatitis, dye dermatitis and trade eczema. In this type of eczema, ultraviolet irradiation may accentuate the symptoms, especially if the treatment is used on the acute exudative form of the disease. Long-continued contact with an irritant causes the skin to become thickened, erythematous and pruritic. This stage of dermatitis venenata may be considerably ameliorated by carefully regulated doses of ultraviolet rays.

*Infantile Eczema.* — The term infantile eczema simply indicates eczema occurring in infants, and the type may be any one of those enumerated or a combination of them. Most cases, however, are of the allergic type due to sensitivity to some food. Most eczema occurring in infants or adults is benefited by exposure to ultraviolet rays. This is not indicated, however, in the acute, vesicular type. General irradiation of the body is particularly desirable in selected cases of chronic eczema. In this disease, as in many others, the cause should be sought and removed if found. One should depend not on ultraviolet rays alone for therapeutic results but also on topical remedies.

*Infectious Eczematoid Dermatitis.* — This condition is usually generalized and develops secondarily to a discharging sinus, ulcer or infected wound. Generalized and localized ultraviolet irradiation may increase the general resistance of the patient and may help to overcome the condition in an indirect manner. Short wave ultraviolet rays are particularly desirable because of their bactericidal effect. In some cases surgical intervention is required to remove the infectious focus.

*Intertrigo.* — This condition occurs in locations where opposing surfaces of skin are in contact and is due to friction, heat and unhygienic conditions. When ultraviolet rays are combined with appropriate topical remedies it responds satisfactorily.

*Neurodermatitis.* — There are two common forms of this condition — the circumscribed and the disseminate. The circumscribed type is seen most frequently in adults and resembles patches of chronic eczema occurring in the flexures of the elbows and knees, on the sides of the neck and in the occipital area. The disseminate type is most recalcitrant and distressing. It occurs in allergic persons and is more common in infants and children than in adults. Itching is almost intolerable at times. General irradiation of the body is certainly of value in the treatment of both types of neurodermatitis. Heliotherapy combined with sea bathing is especially efficacious. Even localized varieties of this condition should be given generalized treatments with ultraviolet rays. Neurodermatitis is most difficult to manage. Treatment with ultraviolet rays is only one of the many therapeutic agents that may be required partially to control this disease in some cases. For the

proper handling of neurodermatitis, therapeutic resourcefulness is most essential.

*Erysipelas.* — The treatment of erysipelas with ultraviolet radiation is not only safe but successful, especially in the very young and the old. Many times the erythema dose (eight to twenty) of ultraviolet rays from a quartz mercury arc generator is applied at one sitting to the affected area and to an inch or two of the normal surrounding skin. This treatment is repeated several times on successive days. The literature contains many articles describing in detail the technic of application and the results of treatment. A few of the best articles on this subject are by Ude and Platou, Lavender and Goldman, Titus and Petényi. In view of the effectiveness of sulfanilamide and its derivatives in the treatment of erysipelas, a word of caution is essential. These drugs are photosensitizers. Therefore in treating erysipelas one must not employ ultraviolet rays and sulfanilamide or a derivative simultaneously.

*Furunculosis.* — The general belief among dermatologists is that generalized ultraviolet irradiation is beneficial in cases of long-standing multiple recurrent furunculosis. Either natural or artificial ultraviolet radiation is beneficial. It is my impression, however, that better results are obtained when the patient is exposed to sunlight. Single lesions should be treated by conventional surgical methods. It should be emphasized, however, that the mere application of ultraviolet rays is not sufficient for the treatment of recurrent multiple furunculosis. A search for infectious foci, secondary anemia, diabetes and other systemic abnormalities is required. This necessitates a thorough physical examination, including all appropriate laboratory studies. Everything possible should be done to raise the general health and resistance of all patients with furunculosis and widespread folliculitis. Topical and internal medication is indicated in many cases.

*Leukoderma and Vitiligo.* — The specific causes of these conditions are not known. The conditions are disfiguring, especially when they occur on the hands and face. There is no satisfactory treatment. Some dermatologists have claimed good results from ultraviolet rays applied to the affected areas after they have been painted with oil of bergamot. It is certainly worth while using this therapeutic procedure in the treatment of vitiligo.

*Nevus Flammus.* — The treatment for nevus flammus (portwine stain) is unsatisfactory. Nothing that can be done will completely eradicate a pronounced portwine stain. Exfoliating and blistering doses of ultraviolet rays may improve pronounced lesions and may eradicate faint ones. A second treatment is given as soon as the reaction from the first one subsides, and the treatments are repeated over many months. One cannot hold out too much hope to sufferers from this condition.

*Parapsoriasis.* — Parapsoriasis is rare. Some dermatologists consider it to be a forerunner of mycosis fungoides. There are no subjective symptoms, and as a rule the lesions are generalized. The disease is incurable. Occasionally lesions involute when treated with intensive doses of ultraviolet rays. The rule, however, is that recurrence takes place. It is not possible to cure this condition, and ultraviolet rays are the only agent that can keep it under control.

*Pityriasis Rosea.* — This disease generally runs a course of about six weeks. Even widespread and severe attacks are controlled by light therapy. Apparently it is the exfoliation following ultraviolet irradiation that effects a cure. Therefore use of the cold quartz type of generator is especially desirable. Occasionally pityriasis rosea is severe, with considerable inflamma-

tion. Then ultraviolet radiation should be used in doses insufficient to produce intense erythema. Pityriasis rosea responds satisfactorily in almost all instances under the influence of ultraviolet rays alone.

*Pruritus.* — Essential pruritus, pruritus ani, pruritus vulvae and senile pruritus have been treated with ultraviolet radiations with indifferent results. In some selected cases, however, ultraviolet rays seem to control the itching. The specific effect of this physical agent on pruritus is not thoroughly understood. The technic, dosage and frequency of application should be carefully adjusted to the individual case. Strong erythema and exfoliating doses may increase the symptoms.

*Psoriasis.* — Exposure to ultraviolet rays is probably the best single method for the treatment of psoriasis of all types. The inveterate localized lesions may be treated with erythema doses of ultraviolet rays provided the normal surrounding skin is protected. The most practical way of treating extensive psoriasis is by exposing the entire body to natural sunlight daily. Ultraviolet rays from artificial sources seem to be less efficacious. Goeckerman and O'Leary recommended the use of 2 or 3 per cent crude coal tar ointment applied to all the lesions the night before the body is irradiated. They also recommended that ultraviolet rays be applied daily. There is no way in which psoriasis can be permanently eradicated, but in most cases it can be kept under control with the judicious use of ultraviolet radiations, roentgen rays, topical remedies and appropriate internal medication.

*Sycosis Vulgaris.* — This chronic deep folliculitis affecting the bearded region is often incurable. However, exposure to ultraviolet rays often improves it. During the summer months patients with the condition appear to be much improved. It is believed that this favorable change is due to the action of ultraviolet rays. In some severe cases it is necessary to apply the ultraviolet rays to the entire body as well as to the affected portions. The systemic effects of ultraviolet irradiation favorably influence the local lesions. Topical remedies are usually used simultaneously with heliotherapy.

*Telangiectasis and Nevus Araneus.* — Telangiectasis occurs without discernible cause, as a result of prolonged exposure to the sun, in cases of rosacea, as a sequel to overdoses of roentgen rays and radium and accompanying certain diseases, such as rosacea. Spider nevi (nevus araneus) occur especially in children, but adults may also acquire them. These lesions may be eradicated by exfoliating or blistering doses of ultraviolet rays. The usual apparatus used is the water-cooled quartz mercury arc lamp. Skin which has been damaged by overexposure to roentgen rays and radium does not tolerate such intense ultraviolet irradiation. Therefore telangiectases occurring on skin so damaged should not be overly treated. Most telangiectatic vessels, however, are best treated with electrolysis or light electrocoagulation.

*Tuberculodermas.* — The manifestations of cutaneous tuberculosis are varied. Most tuberculodermas respond to treatment with ultraviolet rays. Those that are most frequently encountered and treated with either natural or artificial sources of ultraviolet rays are lupus vulgaris, scrofuloderma, tuberculosis cutis orificialis, tuberculosis verrucosa cutis, erythema induratum of Bazin and papulonecrotic tuberculide.

*Lupus Vulgaris.* — This form of cutaneous tuberculosis occurs more frequently than any other. The lesions generally begin to develop early in life (during the first or second decade) and progress slowly. The primary lesion is an apple jelly nodule. About 25 per cent of the patients manifest visceral tuberculosis. Small solitary lesions may be destroyed with intensive doses

of ultraviolet rays. If there is no evidence of active visceral tuberculosis, generalized irradiation may also be used. Statistics show that the best results are obtained when the patient is treated with the Finsen lamp. Unfortunately this source of radiation is not available in the United States. So far as can be told, the results are the same regardless of whether natural or artificial light is used. The specific technic, the frequency of treatments, the intensity of the radiations, the wavelength and other factors should be carefully adjusted not only to the patient, but to the special type of lesion to be treated. In some cases destructive doses are required, and in others only supportive treatment should be used. Along with light therapy, it is recommended that treatment include rest in bed, injections of tuberculin, use of the Gerson-Sauerbruch diet and other hygienic measures.

*Scrofuloderma.* — This form of tuberculosis used to be much more common than it is now, and it is usually caused by the bovine tubercle bacillus. The ulcerations may be localized, affecting only the glands of the neck, or may be extensive. The severity of scrofuloderma depends on the virulence of the organism and the resistance of the patient.

The proper treatment of scrofuloderma requires a combination of methods. Everything possible should be done to increase the general resistance of the patient, such as rest in bed, use of the Gerson-Sauerbruch diet, removal of infectious foci, mental rest and fresh air therapy. Injections of tuberculin are often beneficial. Exposure of the entire body to solar radiation is probably better than artificial irradiation. Radiations from the carbon arc and the hot quartz mercury vapor lamp are preferred to the shorter wavelength ultraviolet rays for the treatment of tuberculous ulcerations. The treatments should be given daily in gradually ascending doses to the entire body as well as to the affected areas. Persistence in treatment is often rewarded with clinical improvement.

*Tuberculosis Cutis Orificialis.* — Tuberculosis affecting the orifices of the body is a serious condition. It is indicative of a general breakdown of the resistance of the host to the tubercle bacillus. It may be considered to represent a direct extension of visceral tuberculosis. For example, tuberculosis occurring on the tongue and about the mouth and nose may represent a direct extension of pulmonary tuberculosis and tuberculosis about the glans penis may represent a direct extension of tuberculosis of the kidney. Most patients with orificial tuberculosis have a rapidly downward course which terminates fatally within a few months.

Intensive doses of ultraviolet rays applied directly to the affected areas improve many lesions. Some lesions even involute completely. A few patients obtain only symptomatic relief. The majority, however, are unaffected by ultraviolet irradiation. It must be considered that this form of cutaneous tuberculosis is a manifestation of a systemic disease and that local treatment is only temporarily beneficial. However, no effort should be spared to make the patient comfortable.

*Tuberculosis Verrucosa Cutis.* — Warty tuberculosis occurs in three groups of patients:

1. Those who come in contact with tuberculous cadavers, for example anatomists, medical students and pathologists.
2. Those who come in contact with tuberculous animals, for example veterinarians, husbandmen and meat inspectors.
3. Those who are affected with pulmonary tuberculosis and inoculate their skins with contaminated sputum.

When an area of the skin is inoculated with tubercle bacilli, a lesion resembling a common wart forms. There is no ulceration, and usually there

is no adenopathy or elevation of temperature. This form of inoculative tuberculosis is, of course, different from the primary tuberculosis complex.

Solitary lesions may be treated with intensive doses of ultraviolet radiation from a water-cooled lamp. This method of treatment is particularly beneficial to patients who have recently recovered from visceral tuberculosis or to those who have inoculated themselves with their own infected sputum. In most instances, however, it is best to eradicate lesions of tuberculosis verrucosa cutis with electrosurgical or surgical methods.

*Erythema Induratum of Bazin.* — This disease occurs mostly in young women whose occupations require them to stand for long periods. There is generally a history of tuberculosis either in the patient or in the family. Lesions occur on the backs of the legs and are in various stages of evolution and involution. They start as subcutaneous nodules, and after several weeks the overlying skin breaks down, producing ulcers. The disease responds particularly well when treated with generalized and localized ultraviolet irradiation combined with rest in bed, use of a high vitamin and salt-poor diet and injections of tuberculin.

*Papulonecrotic Tuberculide.* — This disease runs a self-limited course. However, localized as well as generalized ultraviolet irradiation seems to prevent the formation of new lesions and causes the old lesions to involute somewhat more rapidly.

*Ulcers and Wounds.* — Indolent ulcers and wounds that show little tendency to heal can be stimulated by exposure to ultraviolet radiations. Often repeated small doses of ultraviolet rays are preferable to large doses applied infrequently. Other methods of treatment, such as the application of antiseptic and stimulating preparations, should be used along with the application of ultraviolet rays.

### Conclusions

Ultraviolet rays from all sources are used to a considerable extent in the practice of dermatology. There are some diseases that would progress indefinitely were it not for the beneficial effects of ultraviolet irradiation. There are many disfiguring conditions that are definitely ameliorated as a result of the exfoliating effects of ultraviolet rays. When light therapy is judiciously applied, especially in combination with other types of treatment, the course of many dermatoses can be considerably shortened. The well equipped dermatologist has in his armamentarium more than one source of artificial ultraviolet rays. The most important natural and artificial sources have been mentioned. The diseases that may be expected to yield to ultraviolet irradiation have been briefly discussed. A detailed discussion of the symptomatology, the evolution and the involution of each disease and the exact technic of treatment have been omitted. Finally, it must be emphasized that ultraviolet radiation when improperly used can cause serious and irreparable damage.

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### Discussion

**Dr. Russell J. Fields** (Washington, D. C.): I wish to congratulate the essayist on his excellent presentation. I believe he presented the viewpoint of the dermatologist fairly.

Ultraviolet light, especially cold quartz, is, in my opinion, excellent adjunctive and supplementary treatment to roentgenotherapy. I use it as such in various atopic and fungus eczemas in the subacute and chronic stages. I believe that ultraviolet improves the quality rather than the quantity of roentgen rays. This may sound unscientific but it is the best way I can express my opinion. I have little occasion to use ultraviolet irradiation alone except in the receding stages of pityriasis rosea. I also use it in erythema nodosum, erythema induratum, boils, erysipeloid, erysipelas and some pyodermias.

I believe suberythema doses for most of these diseases should be the rule. I cannot say that cold quartz is superior to ultraviolet from hot quartz or carbon arc because I have not had an opportunity to compare them.

I am certain that ultraviolet irradiation helps psoriasis especially when used following the application of coal tar in one form or another. I do not use ultraviolet

in acne except occasionally for its peeling effect or in conjunction with red heat rays.

**Dr. A. A. Martucci** (Philadelphia): Light therapy in dermatology as presented by Dr. Cipollaro is enlightening and instructive. There are, however, a few points regarding technic about which I would like to inquire. Should short or long intervals space the treatments that are given? I believe this is of the utmost importance in the treatment of diseases of the skin with ultraviolet irradiation.

In my experience I have seen localized lesions of the skin show no response to the application of the air cooled unit, that have cleared up well with the application of the water cooled unit at close contact with the skin. Where the ratio of exposure of time is the same, I am interested in the explanation of the difference in results.

I also wish to ask Dr. Cipollaro whether these patients who have a dermatosis and who are given a series of treatments, what is the extent of the series of treatments. When would one know that the treatments are not considered of benefit? I would also like some explanation of, for example, why one case of impetigo will respond while another treated in the same manner will give poor results?



# RADIANT DISINFECTION OF AIR \*

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PHILADELPHIA

## Equivalent Ventilation

Radiant disinfection of air depends on type of infection, state of suspension, humidity of the atmosphere, volume of space, quality of the radiation, strength of ray, length of the ray, total exposure, uniformity of exposure and air motion. The resultant change in bacterial density of standard organisms suspended in air passing from one point to another can be measured bacteriologically and compared with density change in a confined space by pure air replacement.<sup>1</sup>

The number of organisms killed is proportional to the lethal radiation intercepted by the living organisms.<sup>2</sup> Both disinfection rate under uniform exposure and removal rate by uniform air displacement (with rapid mixing) are

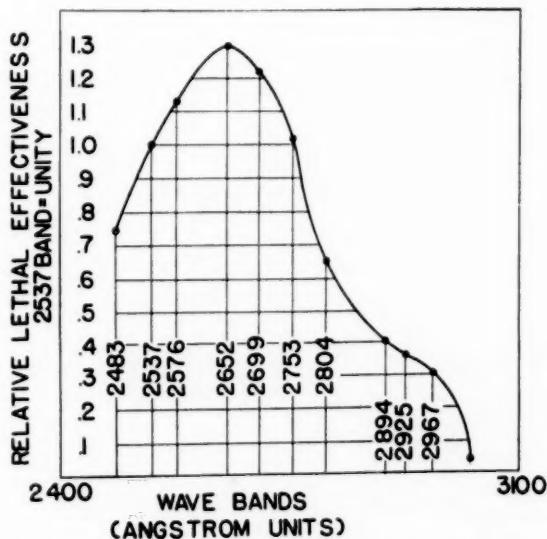


Fig. 1. — Relative bactericidal effectiveness of ultraviolet wave bands compared with 2,537 angstrom resonance band of mercury (computed from data by Gates.)

proportional to bacterial concentration and therefore to each other. Since air change per hour has proved convenient as a unit of ventilation, equivalent air changes or overturns per hour become logical units of sanitary ventilation by radiant disinfection. Fractional removal by one air change (0.63) thereby defines a unit of lethal exposure—the letho.<sup>3</sup>

## Bactericidal Radiation

Radiation in the middle ultraviolet portion of the spectrum (2,000 to 3,000 angstroms) is highly bactericidal. The lethal potency of wave bands increases

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<sup>1</sup> Read at the Twentieth Annual Session of the American Congress of Physical Therapy, Washington, D. C., September 2, 1941.

toward the middle of this range. Relative lethal powers of the more important wave bands of the (therapeutic) mercury arc, as determined by Gates,<sup>4</sup> are compared in figure 1, where the lethal power of the resonance band of mercury (2,537 angstroms) is taken as a unity. Exposure to 100 ergs per square millimeter of this wave band eliminates approximately the same proportion of test organisms from agar surfaces as one air change from an atmosphere.

### Humidity

The vulnerability of organisms suspended in dry air, however, is of a higher order of magnitude than that of the same organisms suspended in water.<sup>5</sup> Dryness seems to affect the power of the ultraviolet light to destroy bacteria suspended in air.<sup>2</sup> The effect of relative humidity upon the vulnerability of air-suspended bacteria to radiation from a quartz Uviarc operating at 70 volts direct

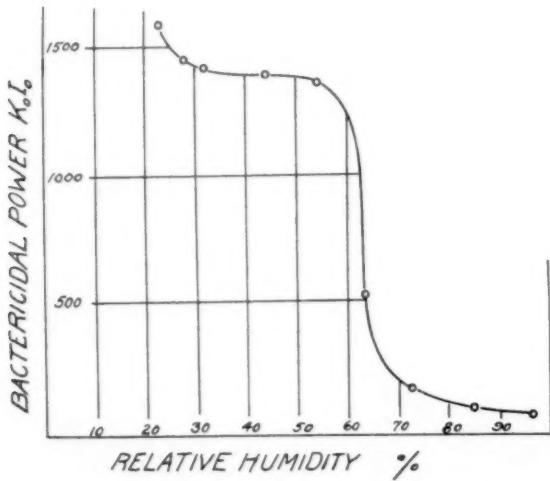


Fig. 2. — Relative bactericidal effectiveness of Uviarc on *Escherichia coli* suspended in air of different humidities (computed from data by Whisler).

current is shown in figure 2, plotted from a retabulation of Whisler's data (fifty-four runs representing more than five hundred air samples).<sup>6</sup>

TABLE 1. — Effect of Relative Humidity Upon Vulnerability of Air-Suspended Bacteria to Ultraviolet Radiation.

(Compiled from Whisler's data.<sup>6</sup>)

Number of Runs	Relative Humidity, %			Bactericidal Power, $K_0/I_0$ Average
	Low	High	Average	
10	.22	.24	23.0	1,588.
7	.27	.29	28.0	1,460.
3	.30	.35	31.7	1,420.
4	.41	.48	44.0	1,395.
9	.50	.58	54.3	1,365.
7	.60	.67	63.0	530.3
4	.71	.73	71.8	174.2
8	.81	.89	84.1	95.1
2	.95	.97	96.0	69.0

### Lethal Exposure

The bactericidal effectiveness of ultraviolet light against *Esch. coli* suspended in air abruptly falls below a tenth of its former magnitude within a critical region between 50 and 75 per cent saturation. Only a tenth to a twentieth of the exposure required in humid air, in aqueous suspensions or on agar surfaces is necessary to accomplish similar results in dry air. Four ergs of 2,537 angstrom length seem from the best available data to expose a square millimeter to 1 lethe.<sup>3</sup> Maximum lethal efficiency, requiring uniform exposure, is, however, a theoretic limit. Milliwatts per square foot provide more convenient approximations to lethes per minute in practical application.

### Uniform Lethal Intensity in Space

Uniform flux density yields maximum lethal exposure. Uniform parallel radiation gives uniform flux density in space. Radiant flux required to irradiate uniformly a given volume of space to a given flux density depends, however, on the form of the space. If a cube of volume equal to a given space is taken as the standard form, maximum uniform flux density equals radiant flux divided by cube root of the volume squared. This will be called the uniform cubic flux density.

### Uniformity Factor

Average intensity multiplied by the volume expresses nonuniform irradiation within a space. Average nonuniform flux density is always less than uniform intensity in a cube for a given flux, and the ratio between the two gives a convenient uniformity or irradiation factor.

Locations of radially emitting sources, as well as space dimensions, determine irradiation. Central sources yield high uniformity factors, a maximum of 1 divided by the cube root of  $4\pi/3$ , or 0.62 for a point source located at the center of a sphere.

### Radiant Distance

Conversion of radiation into irradiation thus is a design problem. Unit radiant flux in a uniform parallel beam, through unit distance, uniformly irradiates unit volume to unit intensity. Radiation in milliwatts through distance in feet becomes irradiation milliwatt-feet, or average intensity multiplied by volume. Ray length and strength are equally important in air disinfection. A milliwatt-foot minute is thus capable of irradiating a cubic foot to approximately one lethe—a foot-lethe.

The distance between radially emitting sources and the enveloping surfaces which absorb radiation is as important as the lethal power of the sources in determining radiant disinfection of confined atmospheres. Average intensity multiplied by volume is equal to the summation of products of lengths and strengths of the rays. Summation of the products of solid angular flux densities from a point source times distance to the first intercepting surface expresses irradiation in milliwatt-feet of unreflected radiation. Average radiant distance divided by the cube root of the volume gives a practical index of irradiation in many confined spaces.

### Reflectors

Neither full room dimension nor total flux of radiant sources is available for irradiation of enclosed spaces. Utilization of the former requires reflectors which absorb a large fraction of the radiation before irradiation. Interior surfaces ordinarily absorb lethal radiation, though a small amount of reflected radiation may yield a disproportionate amount of irradiation because of extended travel lines. Tolerance requirements, however, seldom permit re-

flection from interior surfaces to increase footage enough to raise the irradiation factor to unity, but reflection is of course basic in fixture design.

### Variable Intensity in Space

Milliwatt-feet minutes can be directly translated into foot-lethes only when radiant flux density is uniform throughout the enclosed space. Only when uniform disinfection rates maintain uniform infection densities are disinfection functions by irradiation and by air replacement identical. If intensity varies the density of surviving organisms will also vary, and the more variable the light intensity or bacterial density, the lower will be the lethal exposure.

### Recirculation

Irradiation of recirculated air distinguishes clearly between mixing and irradiation factors. Disinfection rate within the room is practically determined by rate of recirculation, uniformity of irradiation being negligible.

Consider two chambers of different size so connected that air can be circulated between them. Assume such similarity of form as to give comparable distribution of radiant flux in each. Disinfection in the one by irradiation of the other can result only by circulation. Exposure of organisms in the one by irradiation in the other increases with recirculation, approaching a theoretic limit determined by the ratio of the diameters of the two chambers. Even with infinite recirculation, lights installed in the rooms would, because of large dimensions, accomplish much more disinfection than the same lights installed in a duct.

Recirculation rates actually are limited to small fractions of disinfection rates. Theoretic efficiencies obtainable where circulation rates are high compared to disinfection rates cannot be aspired to. Equivalent air changes of recirculated air in the room, regardless of the disinfection rate in the duct, approach equal displacement with outside air (minus only the percentage of organisms surviving irradiation). Ten overturns per hour obtainable by good practice represent low standards of sanitary ventilation obtainable by lights in the room.<sup>7</sup> Diminishing returns, because of the exponential nature of the disinfection function, quickly increase the unit cost of irradiation, and increasing recirculation likewise soon becomes prohibitive.

### Circulation

Similar factors determine utilization of variable intensities of radiation within a room. Natural circulation rates as compared with disinfection rate determine disinfection factors. Utilization of circulation depends on distribution of light intensity. Circulation by convection currents from smaller, less intensely irradiated portions of space through larger, more intensely irradiated zones depends on proportions and spatial relationships of the variably irradiated volumes. Variability of bacterial density may empirically indicate low circulation utilization.

### Sanitary Ventilation

Lethal efficiency (lethes per minute/uniform cubic flux density) resulting from the product of all these factors determines radiant sanitary ventilation. Lethal efficiencies determined bacteriologically in standard classrooms have been plotted in figure 3 against uniformity factors computed from photometric measurements.<sup>8</sup> For good design ranges it appears that foot-lethes of ventilation approach milliwatt-feet minutes of irradiation.

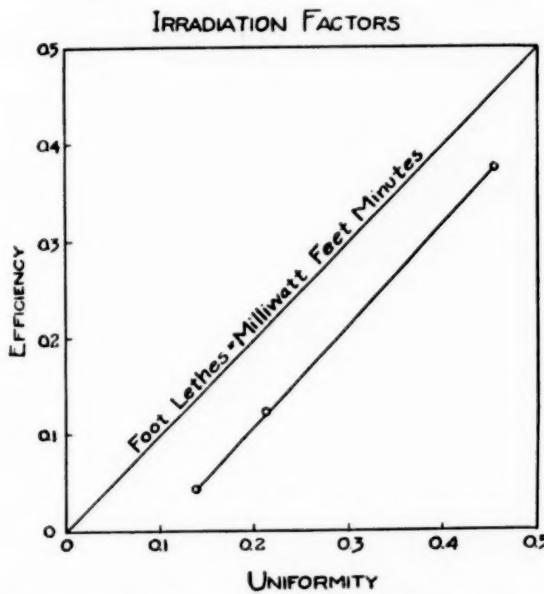


Fig. 3.—Lethal efficiency (lethes per minute/uniform cubic flux density) plotted against uniformity factor (average flux density/uniform cubic flux density). Quotient gives exposure factor (foot-lethes/milliwatt-feet minutes).

### Barriers

Barrier isolation by bactericidal curtains provides a special case of radiant disinfection. Bacterial imperviousness to passage of infection depends on velocity and total radiant flux traversed, and for uniform velocity the approximate penetrability of curtains from tubular sources is inversely proportional to the radiant flux per unit length of curtain.

### Radiant Disinfection

Foot-lethes of sanitary ventilation must, in the final analysis, be determined by bacteriologic methods. Intelligent application of the physical and biologic factors involved in irradiation and sanitary ventilation may, however, guide in designing and installing efficient fixtures and in defining regulatory standards of practice. The fundamental hygienic specifications of radiant disinfection must depend ultimately on the correlation of effective foot-lethes per occupant per minute with epidemiologic indices.

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### Discussion

**Mr. Howard A. Carter** (Chicago): Considerable investigation has been done in radiant disinfection of air and it would seem as though progress is being made. The other day a salesman came to the office of the Council on Physical Therapy with pictures of ultraviolet apparatus and he wanted the Council's acceptance of them. One device consisted of a lamp comparable to the cold quartz variety with a tube shaped in such a manner that it could be inserted in shoes for alleged sterilization purposes. Another device consisted of a circular tube supported in such a way that it could be placed over a toilet seat. He said it was for sterilizing the seat. Another person displayed a device, the purpose of which he said was to sterilize the drinking glasses in restaurants or cafeterias.

A well known hotel in New York City advertises a device for sterilizing bathrooms. It is a variety of cold quartz ultraviolet light placed on wheels and may be moved from bathroom to bathroom. The enclosure is said to be sterile when the door is sealed by a small piece of cellophane.

I believe that many of the listeners in attendance at this meeting are interested in these products and I should like to ask Professor Wells to comment on the devices.

**Dr. Frank H. Krusen** (Rochester, Minn.): I have been much interested in the employment of ultraviolet radiation for sterilization of air and of solid objects as mentioned by Mr. Carter. As one travels out the Pennsylvania Super-Highway, one finds ultraviolet sterilizing devices which are supposed to sterilize completely the toilet seats in the public comfort stations. One New York hotel now advertises that it can sterilize an entire bath room by placing an ultraviolet lamp in the center of the room; and then after a brief irradiation, the doorway is sealed with cellophane. Whereas it is becoming more and more evident that ultraviolet radiation is especially efficacious in sterilizing the air within a room, it is obvious that solid objects with irregular surfaces cannot be so

sterilized. It is unfortunate that the excellent investigations on sterilization of air are clouded by such flagrant exploitation of procedures which are obviously ineffective. Like Mr. Carter, I should like to hear Doctor Wells' comments concerning this problem.

**Dr. L. D. Frescoln** (Philadelphia): I would like to ask Dr. Wells if he can tell us how far, by cities and states, institutions may be considered legally responsible for adopting such apparatus in their operating rooms as well as in public schools.

**Prof. William Firth Wells** (closing): Ultraviolet sterilization of surfaces is a problem on which our studies throw little light. The particular organic substances in which bacteria are enveloped absorb the radiant energy and lower the efficiency of sterilization. It is also true that organisms suspended in the minute evaporated residues of droplets expelled from the respiratory passages are less protected from the rays than are those in bacteria-laden dust. The control of epidemic spread of contagion, since it is a problem of disinfected air-borne nuclei, thus requires less irradiation than prevention of hospital cross-infection, in which dust-borne microorganisms seem to play an important role. It is manifestly unsound to apply conclusions drawn from the study of air disinfection to the destruction of organisms in other media.

In this paper, I have attempted to impress the users of radiant energy with the complexity of the factors entering into each particular problem, and the necessity of considering each problem separately. We ourselves cannot presume, after six years study, to a very complete understanding of even the one very special case of droplet nuclei contagion—far less air-borne dust cross-infection in hospitals—and none at all of the true problems mentioned by Mr. Carter and Dr. Krusen, on which we have done no work whatsoever.

The question of legal responsibility for measures to prevent air-borne infection, raised by Dr. Frescoln, is outside the purview of our Laboratories.



## THE HAZARD OF BURNS FROM ORIFICAL ULTRAVIOLET APPLICATORS

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Two types of orificial ultraviolet applicators are available for irradiating the fundus of deep cavities. The first type, in common use some two decades ago, consisted of a cylindric rod of fused or crystalline quartz about 10 cm. long and 6 to 20 mm. in diameter.

With the applicator mounted end-on close to a quartz mercury arc lamp, the ultraviolet rays entered one end and emerged at the other end of the rod.

The physical properties of this type of applicator-rod are interesting. Light traversing an optically dense medium (quartz) is totally reflected at the boundary wall with the rarer medium (air). Hence, in traversing the quartz rod but little light escapes through the side walls, and there is but little danger of injury to the close-by walls of the cavity, and of the orifice, by burning by ultraviolet radiation.

The second type of orificial applicator, recently introduced, consists of a thin-walled cylindric quartz tube about 10 to 15 cm. long and 5 to 15 mm. in diameter, with a thin quartz glass partition extending lengthwise through the tube, thus forming two contiguous tubes, containing mercury vapor. A high potential electric discharge passes down through one tube and back through the other tube. The end of this double tube forms the applicator for irradiating the fundus of a cavity. From the very manner of construction of this type of mercury vapor discharge tube, and the distance involved, the energy density (intensity) of the ultraviolet radiation emanating from the side of the tube is greater than that emanating from the end of the tube. Obviously, unless the side of the tube is covered with a suitable jacket, ultraviolet rays can emerge and irradiate the side walls as well as the orifice of the cavity.

Therein lies the danger of injury from burns by ultraviolet radiation, which in this type of burner is essentially "cold quartz" radiation, over 95 per cent of which is concentrated in the resonance emission band of mercury vapor of wavelength 2,537 angstroms.

Fully convinced that the second type of ultraviolet applicator lamp can be operated on wrong principles, under the following headline I present experimental data to prove my thesis. This is substantiated by clinical evidence showing that it is practically impossible to construct "fool-proof" apparatus that cannot be misused however well intentioned the operator. For example, some years ago an operator attempted to irradiate the interior of an infected bladder by insertion of an unshielded ultraviolet applicator into the urethra.<sup>1</sup> As a result the patient was badly burned and had to be hospitalized, and for some time the urine had to be drained through the abdominal wall. All the pain and suffering could have been avoided if the side walls of the applicator had been suitably shielded to prevent emergence of ultraviolet radiation.

### Effects of Irradiation With the Side and the End of an Ultraviolet Applicator

It is impracticable to make accurate radiometric measurements on the intensity of the ultraviolet radiation close at the contact end (and side) of an orificial lamp. Instead, two sets of erythematogenic tests were made (on the

inner part of the forearm and inner part of the upper arm, respectively), a small oral applicator operated on 10 and on 20 milliamperes being used to determine the intensity of the ultraviolet radiation emanating from the end and from the side of the lamp.

In order to have sources (side and end) comparable in size, the applicator was covered with a close-fitting tube of brown cardboard painted with lampblack on the inside to prevent reflection of radiation. A rectangular

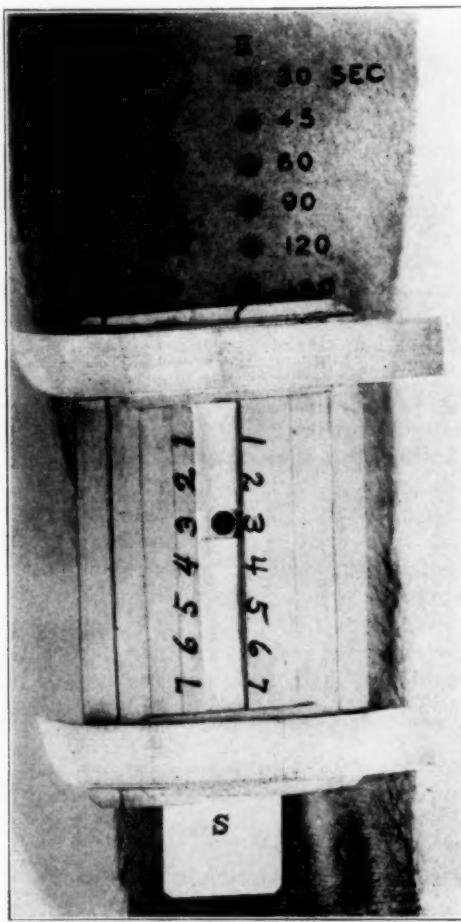


Fig. 1. — Photograph showing erythema and tan on the inner part of the forearm seven days after irradiation with an official ultraviolet applicator operated end-on (column I) and sidewise (column II). Lower part, shield through which exposures were made.

hole 5 mm. wide (practically the same as the end of the applicator as used in practice) cut in the cardboard permitted irradiation with the side of the lamp.

In making the erythematic exposure tests the inner part of the forearm (fig. 1) and the inner part of the upper arm (fig. 2) were covered with a cardboard shield perforated with a row of seven holes, each about 4.5 mm. in diameter, as shown in the lower part of the illustrations. In these tests a white cardboard slider (*S*, figure 1) with a suitable opening permitted individual exposures (as shown at no. 3 in figure 1), which ranged from thirty to one hundred and eighty seconds.

Vertical column I of dark spots shows the series of erythema (and tanning) exposures seven days after irradiation with the end of the applicator held over the opening in (and in contact with) the cardboard shield. Similarly, vertical column II of dark spots shows the effect of the exposures to the ultraviolet radiation emanating from the side of the applicator held over the opening in the cardboard shield. In this case the thickness of the cardboard ways that support the slide prevented the applicator tube from making

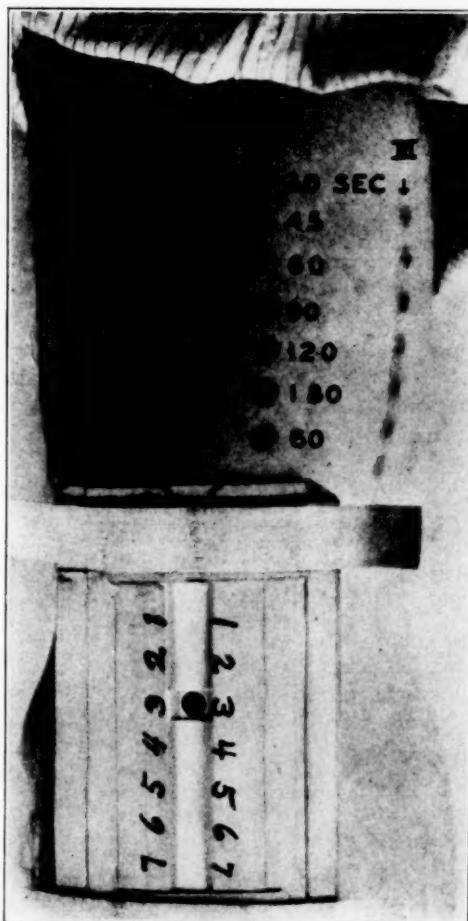


Fig. 2.—Photograph showing erythema and tan on inner part of upper arm seven days after irradiation with an official ultraviolet applicator operated (column I) end-on and sidewise (column II) on 20 milliamperes through the lamp and on 10 milliamperes (column III). Lower part, shield through which exposures were made.

contact with the cardboard shield. However, the difference in distance was negligible.

In this test the lamp was operated on 20 milliamperes. All the exposures produced second and third degree burns that were still bright red (some were painful) four days after irradiation. Even when the lamp was operated on only 10 milliamperes, as shown in column III of figure 2, all the exposures were too long. In this test the cardboard shield was not in close contact with the arm and scattered ultraviolet radiation produced between the openings an erythema still visible seven days after exposure.

While it is not very evident in figure 2, visual comparisons of the erythema response showed that the ultraviolet radiation emanating from the side of the applicator was at least one and a half times as intense as that from a similar area on the end of the applicator.

The development of erythema and tan when this type of ultraviolet radiation was used was an interesting study, showing why experimenters differ so in their descriptions of their observations.

As shown in figure 1, the forearm was already tanned by exposure to sunlight. One hour after irradiation all exposures appeared red, those from the side of the applicator (column II) appearing bright red. After seven days (when these photographs were made) all the exposures showed a brownish tan, and ten days after irradiation all exposures began to fade. Two weeks after irradiation the exposures to the end of the applicator (column I) had practically disappeared (desquamated), but the exposures to the side of the applicator (column II) still showed prominently, and the desquamating patches of epidermis could be lifted off (with tweezers) as round disks. Three hours after the area was washed with alcohol practically no tan was visible.

On the other hand, the exposures on the untanned inner part of the upper arm (fig. 2) responded according to expectation. The strong over-exposures (no. 5 and no. 6) showed faint erythema after two hours, but some four hours elapsed before the short exposures (no. 1 and no. 2) became visible. In contrast with the exposures on the forearm, seven days after irradiation (fig. 2) all the exposures were still inflamed and decidedly red. Two weeks after irradiation the desquamating disks from column III could be lifted with tweezers, but the epidermis devitalized by the end (column I) and by the side (column II), 20 milliamperes having been used, still adhered tightly. Washed with alcohol, three hours later all these exposures showed a vivid reddish brown tan almost as distinct as the seven day old erythema-tan shown in figure 2.

The dark part of the arm to the left of column I in figure 2 is erythema caused by accidental exposure to the lamp — perhaps reflection from the table. This desquamated three weeks after irradiation.

All the irradiated areas, columns I, II and III in figure 2, after desquamating were still visible as conspicuous brown spots (tan) two months after irradiation.\* In contrast, the effect of the exposures on the forearm (fig. 1) had completely disappeared.

In conclusion, from the evidence presented it seems to me that unless it is properly jacketed the quartz discharge tube type of ultraviolet lamp is a hazardous means of irradiating cavities deep within the human body. It is true that such lamps have been used successfully; but it is also true that the device in the hands of the unwary has caused needless pain and suffering. The remedy is simple and obvious. A covering of the side of the applicator with a glass tube that can be sterilized or with paper or woven fabric tubing that can be discarded seems to be the quickest means of shielding the applicators now in use. The new models could be made with side walls of glass that is opaque to ultraviolet radiation.

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#### Reference

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\* As this paper goes to press, four months after irradiation, these brown spots are still visible.

# THE PHYSIOLOGIC EFFECTS OF RADIANT ENERGY\*

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Solar radiation or sunlight consists of three portions, (1) that which we see, (2) another one of shorter wavelengths than this visible or luminous part—the ultraviolet, and (3), a portion of longer wavelengths—the infra-red. The energy emitted by artificial sources similarly consists of these three divisions in varying proportion.

## The Skin

Important effects are mediated by the changes produced in the skin and it is logical to begin our discussion with this organ, which is not only protective but endowed with nervous, nutritional, circulatory and excretory functions as well. Its exposure to radiant energy improves its blood supply and thus its metabolism and results in general improvement (Laurens 1933, 1935, 1936, 1938).

The almost immediate reddening of the skin during and after irradiation is due to radiant heat (infra-red and long luminous). This heat hyperemia, frequently mottled and not restricted to the part irradiated, soon disappears to be succeeded, after a latent period of an hour or more, by an erythema due to the action of the ultraviolet rays, and which, according to the intensity of the radiation, may be combined with blistering and hemorrhage. The inflammation lasts for some time to be followed by peeling and pigmentation. The dermatitis, the end result of the aggregation of colloidal particles, is the pathologic outcome of the skin's physiologic response. Using ordinary intensities the longest wavelength that produces erythema is between 3150 and 3200 Angstroms. The curve representing relative effectiveness of different wavelengths rises to a maximum at 2967, descends to a minimum at 2800, then rises to another maximum between 2500 and 2400 and extends to an undetermined shorter wavelength (Laurens 1933, 1935, 1936; Blum 1941a).

Hausser and Vahle showed that, if the dose required to produce an arbitrarily selected first degree erythema is exceeded, the degree of redness after irradiation with 2540 Angstroms increases approximately proportionally to the dose; on the other hand that with other wavelengths even a slight overstepping of the dose required for a first degree erythema results in a marked increase in the degree of redness and may even cause blisters. This effect shows a gradual increase from 2540 through 2890, 2970, 3020 to 3130 Angstroms (Ellinger, 1941).

Certain persons are more susceptible to sunburn than others, and the curve of development and disappearance of erythema varies widely. Blonds are more sensitive than brunettes, men than women, persons between twenty and fifty more than those younger or older. There are two seasonal sensitivity maxima in March-April and in October-November. An unstable nervous system, an overactive thyroid gland, elevated blood pressure or active tuberculosis increases sensitivity. The sensitivity increases at the menses, a maximum being reached on the first day. After the second month of preg-

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\* The symposium is being published as a monograph by the A. A. A. S.

nancy the sensitivity markedly increases until the seventh, after which it diminishes somewhat, being still high at term (Ellinger 1941; Laurens 1935).

Erythema is ordinarily and normally followed by pigmentation, the primary changes being the same. There are wide differences in the production of pigment in different persons. The ectodermal pigment is almost exclusively in the basal cells, migrating to the outer layers only when the skin is well tanned (Laurens 1935, 1936; Blum 1941a). The first event in pigmentation is the migration of pigment already present in the basal cells to more superficial layers. The formation of new pigment in and by the basal cells takes place later. In negroes, pigment is not only more abundant in the basal layer than in whites but there is also much pigment scattered through the prickle cell layer and even in the horny layer.

The essential function of pigment, arising as it does as a physiologic response to over stimulation, has been naturally and logically considered to be one of protection against continued overaction of the sunburn spectrum. The well tanned skin of persons accustomed to life out of doors does not burn on exposure to sunlight which acts painfully on the bleached skin of those not so accustomed. But the process of adaptation in sunburned skin also consists of proliferation by the malpighian layer and in cornification, so that the horny layer and the epidermis as a whole becomes thicker. The prickle cells, where the processes of inflammation take place are thus protected from the excessive action of the damaging wavelengths. A third, but apparently minor, part of the process of adaptation is found in chemical changes in the proteins of the prickle cells as a result of which they become better screens (Laurens 1933, 1935, 1936; Blum 1941a).

Wavelengths shorter than about 3000 Angstroms are absorbed by the horny layer and outermost cells of the malpighian layer and thus never reach the basal cell layer. The horny layer is the protecting screen for the living epidermal cells, preventing overaction on them of shorter ultraviolet rays. Longer waves penetrate as far as the cutis or corium. The increased amount of pigment in the prickle cells and in the basal cells, which follows irradiation, regulates the amount of this longer waved energy and thus protects the underlying cutis from being acted on by too much energy. Pigment is the protecting screen for the papillae of the dermis and the subcutaneous tissues, preventing overaction by the longer ultraviolet rays (Laurens 1935, 1936; Blum 1941a). The function of skin pigment as a screen for the ultraviolet is relatively insignificant in the white race, of more importance in dark-skinned races and is the main reason for the low sensitivity of the negro to ultraviolet. Skin pigment offers no protection to deeper tissues against the longer infra-red wavelengths and but little protection against shorter infra-red and visible energy (Laurens and Foster 1937). A film of sweat partly screens the skin against erythema producing radiation (Crew and Whittle 1938).

Pigment formation and therapeutic benefit are independent, coordinate phenomena proceeding simultaneously in the same direction. Pigment formation depends on individual factors, race, sex, coloring, constitution and body function. It can be used as an index in treatment and as a measure of adaptation since it runs parallel with thickening of the skin and changes in the protein of the cells of the skin.

Long wave ultraviolet radiation has effects which are different from those of short wavelength. Following irradiation of the skin with energy extending from 3200 to 4800 Angstroms there is a marked, deep red erythema. The maximum effect is produced at 3850 and there are two smaller maxima at 3600 and 4080. A slight erythema at 3850 produces marked tanning,

at 2970 hardly any. The erythema threshold at 3850 is 500 times that at 2970. If the intensities are so chosen that the same degree of erythema is produced at 2970 and at 3850, the latter reaches its maximum in two to three hours, while that at 2970 is just becoming noticeable. In twelve hours each shows maximal reddening, but the color obtained following the use of 2970 is carmine red, whereas with 3850 it is brown red. In forty-eight hours the erythema produced at 3850 is brown, at 2970 still maximally red. In five weeks the erythema produced by 3850 is still definitely brown, and that produced by 2970 barely noticeable (Hausser 1938; Henschke and Schulze 1938; 1939; Miescher 1937, 1939; Miescher and Minder 1939; Laurens 1941; Blum 1941a).

The formation of pigment in the skin following the production of erythema by these longer wavelengths is also quite different from the conditions present when wavelengths shorter than 3150 Angstroms are used. It may take place without preceding erythema (Miescher 1939), and is probably due to the oxidation of pigment already present in a colorless reduced state, a reversible process independent of the formation of new pigment (Miescher and Minder 1939). This is the reason why pigmentation (tanning) is more intense following sunburn by sunlight or the energy from a carbon arc than by a mercury arc in quartz (Henschke and Schulze 1939b). The sun and carbon arcs emit energy rich in long wave ultraviolet.

Ultraviolet irradiation forms or liberates active substances in the skin which are responsible for the erythematic response and for pigmentation. The structural changes are almost entirely limited to the stratum mucosum and the erythematic response seems due to the photochemical decomposition of a constituent of these cells with the liberation of active reaction products. These diffuse to the region of the minute vessels of the subpapillary venous plexus of the corium and lead to vasodilation. The active substance is probably a typical protein or a simple derivative. The photooxidation of typical proteins with wavelengths from 2350 to 3150 Angstroms leads to the formation of proteoses and similar products. It is a plausible hypothesis that the active substance is a derivative of the proteins of the cells of the stratum mucosum, that it is an H-substance, that is, a substance with some of the functions of histamine, if not histamine itself, and that it is in the form of an H-colloid (Mitchell 1938). It is reasonable to believe that erythema is a sequel to injury to the prickle cells produced by wavelengths shorter than 3150, and that this injury is of the nature of coagulation or denaturation of the protein of the prickle cells of the epidermis. Blum (1941a) believes that the simplest explanation is that the erythemic mechanism is composed of two rather distinct parts. The first is a photochemical reaction which determines the amount of radiation necessary to produce the erythematic response, which like most photochemical reactions has a low temperature coefficient. This reaction takes place principally in the prickle cell layer, but sets off other reactions which result in the production of substances which cause the dilation of the minute vessels in the papillary layer. It is these secondary reactions which occupy the latent period.

Pigmentation too, is readily explained on the basis of cell injury as it is generally preceded by erythema. The migration of the pigment from the undamaged basal cells into the injured cells of the more superficial epidermis is due to the tropic action of some chemical substance set free by the injured cells. The formation of new pigment in the basal cells themselves may be explained by the action of some substance elaborated by the injured cells (Blum 1941a).

Evidence against and for the H-hypothesis of inflammation has been recently published (Menkin 1938, 1940, 1941; Rocha e Silva and Dragstedt 1941). Abramson (1940) cites observations which, to him, do not support the view that histamine or a readily diffusible H-substance of low molecular weight is responsible for the skin response to ultraviolet irradiation. von Kolnitz (1940), Laurens and von Kolnitz (1940) and Laurens and Graham (1941) show that carbon arc irradiation definitely increases blood histamine.

### **Wound Healing**

Natural sunlight at high altitude has been shown to hasten the healing of sluggish, indolent wounds (Laurens 1933, 1935, 1946). The effect is due to the entire spectrum and is not restricted to the ultraviolet rays. The beneficial influence is due to longer ultraviolet, luminous and infra-red rays, the ultraviolet rays sterilizing the wound and hastening granulation while the longer wavelengths act indirectly through the hyperemia produced.

Direct irradiation by means of a carbon arc lamp of artificially produced wounds in dogs indicated but little, if any, accelerating effect on the healing of a clean wound (Sweeney 1938). On the other hand sterilization of wounds and of extensive areas of unhealthy granulation tissue can be successfully accomplished by ultraviolet radiation (Gatch 1938), and is done efficiently by a special unit in which over 80 per cent of the output is at 2537 Angstroms (Hart and Sanger 1939; Hart 1940, 1941). Healing is better, there is less danger of infection and less local and systemic reaction.

It seems that when cells are injured by ultraviolet rays they produce a substance or substances, which stimulate cell-proliferation and promote growth (Loofbourow et al. 1940). The centrifuged cell-free fluid from dead irradiated cells is beneficial in wound healing. The nucleic acid-like factors at work are effective in such small quantity that they suggest that they are hormone-like substances produced by living cells and released into the intracellular fluid as a physiologic response to injury. They are probably the natural stimuli to the repair processes in animal tissues following injury. The active materials contain adenine, guanine, pentose and phosphorus.

### **The Eye**

The conjunctiva, cornea, lens and possibly the retina may be damaged when the eye is exposed to strong radiation from arc lamps or to that reflected from snow fields, glaciers, etc. The effects on the conjunctiva and cornea are similar to the inflammatory changes that take place in the skin.

Wavelengths of from about 7600-3900 Angstroms penetrate to the retina and are perceived as light. The aphakic eye sees shorter wavelengths than the normal eye. There are claims that man can sometimes see ultraviolet wavelengths as short as 3130 (Laurens 1933). A recent report (Gaydon 1938) describes the color sensations of an eye the lens of which had been destroyed. This retina is sensitive to wavelengths as short as 3100, the sensation for 3600 to 3100 being blue. The sensitivity in this case was shown not to be due to fluorescence of the retina, although fluorescence of the eye media is the usual explanation of this extended visibility.

Absorption is greatest in the lens, next in the cornea; then in the vitreous and least in the aqueous. The cornea begins to absorb at 3600 and transmits to between 2940 and 3000 Angstroms. The crystalline lens transmits to between 3060 and 4190, according to age. The lens is not damaged by the absorption of wavelengths as short as 2950 unless they are intensified, as by reflection from sand, water, ice or snow, when they produce "snow blindness" or when they are emitted by artificial sources in large amounts.

Shorter wavelengths as emitted by arcs and glowing molten metal and glass are definitely injurious and may produce severe ophthalmia. The damage is usually limited to conjunctivitis and blepharitis, with prickling pain and uncomfortable foreign body sensation. But edema and contraction of the lids and corneal erosion may occur. Long continued exposure may produce functional disturbances, such as color scotomas and constriction of the peripheral field. Amblyopia and central scotoma have been noted in "snow blindness." "Eclipse blindness" is due to intense action of infra-red focused on the retina.

The characteristic effects produced by ultraviolet rays from artificial sources and observed in "snow blindness" are as follows: inflammation of the conjunctiva, cornea and iris; photophobia; copious lachrimation; blepharospasm and ciliary neuralgia. The cornea is hyperemic, swollen and covered with a slimy secretion. Visual disturbances have been frequently observed, such as foggy vision, night blindness, etc., indicating retinal damage. The least effect is slight conjunctival hyperemia and after more intense irradiation the congestion is correspondingly greater and associated with edema and purulent exudation. There may be conjunctival ecchymosis. The corneal epithelium may show marked stippling and be cast off in a day or so and a purulent conjunctival discharge may continue for days as does central corneal haziness. The corneal epithelium is reformed in a few days.

The transmission of the cornea, aqueous, lens and vitreous for red and infra-red is the same as that of a like thickness of water, namely 2.38 cm. Radiation longer than 14000 Angstroms ( $1.4\mu$ ) does not penetrate to the retina of the human eye, that is it is all absorbed, but at the red limit of the visible spectrum (7600) the absorption is not more than between 6 and 9 per cent. Most of the absorption takes place in the outer portions. The cornea absorbs a large proportion of the energy not active in producing light sensation. The iris obstructs the heat radiation of all wavelengths which fall upon it, absorbing the same percentage radiation as that which reaches the anterior surface of the lens, approximately 75 per cent, between 13000 and 7600. The lens, however, absorbs only about 12 per cent of the energy incident through the pupil.

When retinal images are of the same brightness there will be a much greater energy density in the lens when viewing an object subtending a large solid angle than when the object subtends a small angle, if the spectral character of the illuminant and the intensity of the illumination are the same. Large sources of radiation of relatively low visual brightness may thus be effective in injuring the lens or in causing eye fatigue. If the deterioration of the lens is due to ultraviolet, these wavelengths might be present in such small amounts as to appear harmless. But the density of energy in the lens is high when viewing extended objects, such as the sky, pavements, surfaces of glowing molten metal or glass, and so it is likely that ultraviolet is present in amounts sufficient to produce damage. The absorption of energy from low temperature sources, like incandescent lamps and ordinary flames is about 90 per cent, but with the sun the total loss of energy in the eye is not more than between 25 and 30 per cent. In phenomena like "eclipse blindness" not only is the eye exposed to a powerful radiating source but the energy is not absorbed and therefore rises to a high intensity in the focused retinal image. The intensity per unit area is greater in the retina than in the lens or on the cornea, thus the macula is damaged while the lens and cornea are not affected. The retina is coagulated by the heat of absorption of the long luminous and shorter infra-red rays in the pigment epithelium.

Ninety-seven per cent of the energy radiated from low temperature sources, such as a furnace at 1000 to 2000 C. is absorbed in the outer portions of the eye, and injury by the heat rays must therefore occur here, if at all.

### The Blood

The number of reds, whites and platelets may be made to increase by appropriate irradiation, so also the hemoglobin content. (Laurens 1933, 1935, 1936, 1938). Sunlight, or an artificial source as closely approximating this as possible seems to be the most effective. A temporary rise in the reticulocyte count of boys has been reported (Laurens 1941).

Irradiation produces a lowered blood sugar, increased sugar tolerance, increased blood calcium, a relative lymphocytosis and an eosinophilia. In lymph, increases in protein, calcium and cell number, and a decrease in sugar have been observed. A leukopenia in peripheral blood and a leukocytosis in splanchnic blood have been recorded.

Ultraviolet radiation has some effect on secondary anemia but this is limited, not specific and merely adjuvant to established dietetic and drug treatment. There are a few recorded cases of diminished platelet count, diagnosed as idiopathic purpura hemorrhagica, in which carbon arc irradiations resulted in marked improvement (Laurens 1936; Mayerson 1935).

The anti-anemic effect of radiation in tuberculosis may be significant. Bills called attention to the fact that the earliest experiment in which an irradiated remedial agent was administered dealt with the anemia of tuberculosis. Thompson in 1854 found that cocoanut oil as made in Ceylon (by the sun's rays on copra) was almost as effective as cod liver oil, whereas almond oil and olive oil were without action on the anemia of tuberculosis (Mayerson 1935).

Any action of radiation must take place either directly through the blood in the superficial capillaries, or by the formation or liberation in the skin of a substance which diffuses to the layer of minute vessels by which it is absorbed and transported. The greater the hyperemia, that is, the more the capillaries are filled, the more will the active (shorter) rays have a chance to exert their effects. A source which produces a marked hyperemia may be expected to give results differing from one which produces little or none. Temporary increases in blood volume usually accompany the hyperemia (Mayerson 1935).

The influence of ultraviolet radiation on resistance to infection is controversial and highly doubtful. There seems to be no definite or tangible basis for therapy.

### The Circulation

Sunlight and artificial radiant energy may lower blood pressure, normal and elevated. Following irradiation by the use of a carbon arc lamp intense enough to produce erythema, the systolic blood pressure of hypertensives may fall as much as 40 mm., the diastolic 20 mm., Hg. The minute volume output of the heart usually increases when the blood pressure is lowered. The decrease in blood pressure persists for a longer or shorter time depending on the intensity and number of the exposures. By continuing the irradiation at intervals of ten days to two weeks it is possible to maintain these lowered levels of pressure (Laurens 1933; Johnson et al. 1936).

Various explanations of the mode of action of radiation in lowering blood pressure have been suggested (Laurens 1933; Mayerson 1935). We believe that the explanation will be found to be in the local and general vasodilation produced by the setting free of histamine (Laurens and von Kolnitz 1940;

(Laurens and Graham 1941). As a result of tissue injury there are liberated into the surrounding skin, substances with histamine-like action leading to the "triple response," a local dilation, a reflex dilation and an increased permeability of the minute vessels. The drop in blood pressure, following irradiation, may conceivably be due to the action of these vasodilating substances carried in the blood stream to the rest of the body. The effect would be enhanced by the improved blood flow resulting from the vasodilation which usually accompanies irradiation, particularly when erythema producing intensities were used. The more marked lowering of blood pressure obtained with carbon arc than with quartz mercury arc radiation is to be explained, on this basis, by the more extensive hyperemia which the former induces. The carbon arc not only emits ultraviolet and luminous but a considerable amount of penetrating red and infra-red radiation. It produces, therefore, not only an ultraviolet erythema affecting the vessels of the superficial skin layer, but a heat erythema as well, which involves the vessels of the deeper layers. If the effect of radiation in lowering blood pressure is specifically due to the action of the short ultraviolet wavelengths in producing local tissue changes, this effect must be considerably reinforced by the increase in blood flow.

A few years ago we studied the changes in cardiac output together with those in blood pressure in a group of dogs and in normal and hypertensive men after erythema producing doses of carbon arc radiation (Johnson et al. 1936). In normal and in hypertensive men the cardiac output was increased when the blood pressure was lowered, with indications that the increase in cardiac output is accompanied by a corresponding increase in circulating blood volume. Our results suggested a gradual spread of vasodilation. Often, in the studies on cardiac output it was observed that the greatest increase occurred on the second, third, or even fourth day following the exposure, while the erythema always reached its height during the first twenty-four hours. This gradual spread of the vasodilation is best explained by the liberation from the skin of histamine, or an H-like substance, which is absorbed and circulated, and we have been able to demonstrate a very definite correlation between increase in histamine in the vessels and lowered arterial pressure (Laurens and von Kolnitz 1940). Further work on bilaterally adrenalectomized dogs, maintained by injections of synthetic adrenal cortical substance, clearly indicates that the lowering of blood pressure is associated with increased histamine in the blood (Laurens and Graham 1941).

The lowered blood pressure of persons living in the tropics is the result of the action of a number of characteristics, racial, mode of life, meteorologic conditions and their fluctuations. The blood pressure cannot be correlated with the quantity and quality of sunlight. Intense irradiation may markedly accelerate the heart. The pulse may become fuller and stronger during and following a course of irradiations, correlated with increased minute volume. But the pulse rate effects are inconstant and may vary in either direction or show no change.

#### Metabolism

Irradiation of moderate intensity increases endogenous nitrogen metabolism. Residual nitrogen is usually diminished. The excretion of uric acid is said to increase. Ultraviolet irradiation may double the fat content of the blood, cholesterol increasing by 30 per cent (Laurens 1933, 1938, 1941).

The use of ultraviolet and luminous rays lowers the blood sugar in normal men and in diabetics, the action being similar to that of insulin inasmuch as the storage of glycogen increases. It seems as if ultraviolet irradiation had no influence on the activity of the thyroid (Mayerson 1935) but

new evidence points to a stimulating influence as a result of the production of H-like substances in the skin (Ellinger 1941). There is evidence that ultraviolet irradiation may increase the formation and excretion of androsterones (Myerson and Neustadt 1939).

The effect on respiration is to make it easier, slower and deeper. Ventilation per minute does not change. When an increase in metabolic rate is observed on insulating the nude body this is due preeminently to the cooling effect of the moving air. If the air temperature is high with little or no movement, the chemical heat regulating mechanism is brought into action and the metabolic rate diminishes. Brief intense irradiation, producing an erythema, is said to lead to an increase in metabolic rate lasting for as long as twenty-two hours (Lehmann and Szakall 1932; Lehmann 1933). Repeated irradiation produces a diminution of between 10 to 15 per cent in basal rate demonstrable for from three to four weeks after the last irradiation. There is a parallel increased respiratory quotient, from 0.75 to 0.85 to unity, indicating a preferential combustion of carbohydrate. The glycogen storing effect of ultraviolet prevents the lowering of the respiratory quotient after muscular exercise.

Sunlight is one of numerous climatic factors affecting our feelings of mental and bodily well-being. Artificial sources undoubtedly work similarly (Laurens 1933). There is a mild to moderate feeling of exhilaration, of infatigability, produced by moderate doses. This action is obviously an indirect one, consequent to improvement in circulatory and metabolic conditions. Sometimes these beneficial effects may become extreme and border on the abnormal thus merging into the effects of overindulgence—feelings of unrest, more or less vague apprehensiveness, sleeplessness, etc. Hausmann long ago called attention to the harm that may be produced by overexposure to natural sunlight and to its artificial approximations.

#### Mineral Metabolism

Irradiation with ultraviolet shorter than 3130 Angstroms, particularly 2967, activates provitamin D in the skin to vitamin D, the agent which promotes normal calcium anabolism and retention of phosphorus. It thus may prevent and cure rickets, adult and infantile, promote growth and prevent excessive loss of lime from the body. Ultraviolet radiation and vitamin D may rectify partial, but not absolute lack of the dietetic components necessary for bone and teeth calcification. Ultraviolet wavelengths of 3130 and shorter, and vitamin D, cause the organism to operate more economically, they make metabolism more efficient, they permit the organism to have full use of normal processes which are not effective, but they do not bring new processes into operation (Laurens 1933, 1935, 1936, 1938). Carbon arc irradiation apparently does not influence the healing of fractures (Sweeney and Laurens 1935).

The ultimate origin of vitamin D is traceable to sterols activated by ultraviolet rays. It seems apparent that 7-dehydrocholesterol is the significant provitamin D of the skin (Laurens 1941). Vitamin D in some way regulates the passage of calcium and phosphorus across the intestinal wall. It exerts its action by raising the blood calcium and/or phosphate. This is associated usually with an increased net absorption from the intestine, though under certain circumstances the bones may provide the calcium and phosphate. The net retention is the resultant of two opposing factors: (1) Increased absorption from the intestine or diminished excretion to it and (2) increased excretion by the kidney. The primary effect of vitamin D is mobilization of inorganic phosphorus. Calcium thus enters into combination and its deposition in cartilage is promoted. At the same time, calcium and phos-

phate excretion via the intestine is diminished, thus loss of base is retarded and acidosis counteracted (Ellinger 1941).

#### Photodynamic Action or Sensitization

Since the appearance of Blum's book (1941a) on Photodynamic Action and Diseases Caused by Light it is hardly necessary to do much more than to refer to and quote from this authoritative source. Many dyes and pigments can sensitize the cells of living organisms to light. The name "photodynamic action" was probably first given because the phenomenon of photosensitization was erroneously thought to be at the basis of photobiologic processes in general (Blum 1941a, p. 3).

The fundamental process is the sensitization of a biologic system to light by a substance which serves as a light absorber for photochemical reactions in which molecular oxygen takes part. These reactions have nothing in common with the normal oxygen metabolism of living systems, but probably represent oxidations of structural components of the cell which do not take place thermally, at ordinary temperatures, but which do take place photochemically in the presence of a photosensitizer. This is an instance of photosensitization in the photochemical sense. To distinguish it from other types of photosensitization in living systems it has been given the name of "photodynamic action."

Sensitivity to light among humans is usually regarded as rare but it seems probable that cases are not extremely uncommon (Blum 1941a, p. 5). Recent studies indicate that sunlight may play an important role in the occurrence of skin cancer. Several types of sensitivity may be distinguished and photodynamic action is not the etiologic basis for all. Sensitivity to light occurs as a result of the administration of photodynamic substances as well as from contact with such substances.

The wavelengths which produce photodynamic action are those which are absorbed by the photosensitizing substance. The absorbing of a quantum of radiation by the dye or pigment molecule is the initial reaction which sets off the events leading to the observable photodynamic effect, and the absorption spectrum of the dye agrees, with minor limitations, with the action spectrum of the photodynamic process (Blum 1941a, p. 53). One of the outstanding characteristics of photodynamic processes is that they occur only in the presence of molecular oxygen. This oxygen requirement, however, has nothing to do with normal oxygen metabolism. The sensitizer is taken up by the cell so that it is in intimate association with oxidizable substances on which the structure of the cell is dependent, probably protein (Blum 1941a, p. 65, 82). When the photosensitizer molecule is activated by capture of a quantum of radiant energy, it transfers its activation to this substrate which then reacts with oxygen, a reaction which would not occur in the normal course of cell metabolism. Oxidation of the substrate results in damage to the cell structure. In this process the sensitizer molecule is not altered, so that a single dye molecule may bring about the oxidation of many molecules of substrate. There is a great variety of photodynamic effect and many kinds of living organisms and of biologic systems have been subjected to such photosensitization, and the apparent photodynamic effectiveness is influenced by a large number of factors (Blum 1941a, p. 83, 100). There is fundamental distinction between the effects of short ultraviolet radiation and photodynamic action (Blum 1941a, p. 114) and, while the effects may appear to be the same or very similar, the resemblances are misleading, since the two processes are not identical. An important point of distinction between photodynamic action and the destructive effects of ultra-

violet radiation is that while the former takes place only in the presence of oxygen, the latter are independent of oxygen.

Ideas concerning abnormal sensitivity to light in man are confused. Blum (1941a, p. 167) in the interests of simplicity and clarity has suggested the separation of these diseases into two logical groups: (1) those produced by the same wavelengths which normally produce sunburn. The lesions are the result of a derangement of the normal sunburn mechanism and include the majority of abnormal photosensitivities. (2) Those produced as a result of the presence of abnormal photosensitizing substances in the skin and, usually, by the action of rays of wavelengths longer than those which normally cause sunburn.

An example of the second group is the sensitivity sometimes called urticaria solare, in which a triple response is produced by blue and violet light (Blum 1941a, p. 190). This triple response appears quickly, following the exposure to sunlight in a few minutes, whereas sunburn appears only after an hour or more. This triple response also disappears quickly, leaving no visible trace. The photosensitizing substance is a carotenoid of the same type as carotene or xanthophyll. This reaction is not dependent on the presence of molecular oxygen and hence does not belong to the photodynamic type of reaction. There are several other conditions called urticaria solare. In some of these the response is evoked by wavelengths between 4000 and 5000 Angstroms, with a short latent period of only a few minutes. In others the wavelengths which commonly produce sunburn seem to be involved and the latency is a matter of an hour or more, as in normal sunburn.

Blum (1941a, p. 211) has marshaled the evidence to show that porphyrins play little if any part in producing the lesions of hydroa vacciniforme of Bazin. There is no doubt, however, that porphyrins may act as photosensitizers in man. The lesions accompanying excess of porphyrins are often produced by slight trauma and it is possible that this is the usual stimulus for their formation. But light may play an indirect part in their production.

Since most abnormal photosensitivity in man represents abnormal reaction to sunburn radiation (Blum 1941a, p. 239) a variety of abnormal responses and lesions should be expected. In many, sunburn radiation probably simple exacerbates a dermatologic condition whose origin is quite independent of the action of that agent, while in others the lesions appear only after exposure to such radiation. They may all be grouped under the term *polymorphic light eruption*, the lesions being papulous, eczematous or a mixture of the two. They include summer prurigo, eczema solare and summer acne. A few instances show that longer wavelengths than those in the sunburn spectrum are responsible.

Two sets of symptoms have been separated, (1) *eczema solare*, confined entirely to the parts exposed to light; and (2) *prurigo simplex chronica recidivans*, which appears on certain predisposed areas—e. g., the forehead, the outer side of the upper arms and the ankles. Exposure of any region of the body to sunlight exacerbates the lesions on these parts although the sunburn response of the exposed region may be normal. This indicates that substances formed in normal sunburn enter the blood stream and cause exacerbation of lesions on other parts of the body.

There are wide variations in sensitivity to sunburn radiation (Ellinger 1941; Blum 1941a, p. 249). A given dose of radiation which would produce only a mild degree of erythema and pigmentation in one person may produce severe lesions in another. The lesions of the polymorphic light eruptions are abnormal responses which are qualitatively different from those of normal sunburn. Prolonged exposure to radiation, such as sunlight, may

produce changes in normal skin which are more pronounced in some persons than in others and it may be difficult to distinguish between the extreme of normal variation and pathologic conditions (Blum 1941a, p. 251). It has been suggested from time to time that prolonged exposure to sunlight may stimulate the production of malignant tumors of the skin. This has been discussed a great deal recently (Miescher 1937, 1939; Mitchell 1938; Laurens 1938, 1941; Taussig and Williams 1940; Blum 1940, 1941a; Cipollaro 1940). Repeated irritation by ultraviolet rays can cause chronic lesions which may be precancerous, and malignancy of human skin may result from excessive exposure to sunlight (Forum on Sunlight and Cancer 1941). Perhaps by increasing an already present predisposition, causing a tumor to appear earlier and become more malignant. Sunburn—erythema and pigmentation—is a sequel to injury to the prickle cell layer of the epidermis, and the production of cancer may be the result of similar photochemical changes.

If the cells of the basal layer of the skin receive an excessive quantity of radiant energy the two protective processes of cornification and pigmentation become abnormally great (hyperkeratosis and hyperpigmentation) and a third degenerative process starts. Those lacking in pigment or much exposed to ultraviolet rays show the highest percentage of skin cancer. The developing neoplasm occurs in the place of greatest proliferation, beginning in a wartlike hyperkeratosis, a precancerous change. A cancer develops from a precancerous lesion not only as a result of a continuation of the initial insult but as a result of any continued trauma. Thus ultraviolet rays do not cause cancer in themselves. They produce characteristic cell changes leading to precancerous lesions in the skin. Any irritation, including continually and excessively applied ultraviolet rays, can cause the precancerous change to become malignant (Blumenthal 1936).

A recent paper on the production of cancer in white mice (Rusch, Kline and Baumann 1941) is of special interest. The carcinogenic wavelengths were demonstrated to lie between 2900 and 3341 Angstroms. Wavelengths of 2537 or 3341 and longer are noncarcinogenic. The carcinogenic wavelengths thus coincide in part with those most potent in the production of erythema. Radiant energy with a wavelength of 2537 produces erythema but no tumors no matter how large the dose. While in general the length of the precancerous period varies inversely with the daily dose of radiant energy, this period cannot be reduced below two and a half months, no matter how great the daily exposure. Neither the intensity of the energy nor the length of the daily exposure altered the rate of the production of tumors, provided the amount of energy applied per day was the same. Intense doses for short periods daily were as effective as mild intensities applied for longer periods each day. Further, it was not necessary to irradiate the animals throughout the precancerous period. Once initiated, carcinogenesis proceeds without further exposure to radiant energy. In some instances several months elapsed between the end of irradiation and the appearance of tumors.

As Blum says (1941a, p. 254), while it is unwise to apply too directly to man the finding that skin malignancy can be produced in laboratory animals by exposure to light, it is still less wise to minimize the possibility that malignancy of human skin may result from excessive insolation. This is particularly true in a public convinced of the hygienic and esthetic value of sun bathing. Cipollaro (1940) also has called attention to the dangers of overindulgence in solar radiation, the health giving properties of which have been overestimated. He believes that the present vogue of exposing infants

to the sun in the summer and to sunlamps in the winter for many years is bound to result harmfully in later years. Also adults who seek the beautiful bronzing of the skin by constantly exposing themselves to the rays of the sun, may develop not only the ugly changes of "Tropical Skin," but also cancer of the skin.

There also has been much interest in the possible relation between photosensitization and the production of malignancy (Laurens 1941; Blum 1940, 1941a). Some of the carcinogenic substances are active photosensitizers but this does not necessarily mean that light increases their carcinogenic action, although it is possible that tumor production by the carcinogenic hydrocarbons may be increased by an additional effect due to destructive photodynamic action. It is doubtful whether cholesterol is a tumor promoting agent and there is little if any evidence that it becomes carcinogenic on irradiation. It does not act as a photodynamic agent.

Photosensitization has been produced by substances applied internally and sensitivity to light has been reported as a sequel to the use of sulfanilamide and related drugs (Blum 1941). But, though sulfanilamide in high concentration sensitizes human skin to ultraviolet radiation of wavelengths shorter than 3200 Angstroms, producing a response similar to severe sunburn, this is not an example of photodynamic action and the response probably represents an increased sensitivity of the sunburn mechanism of normal skin. Care should be exercised not to expose patients during treatment with such drugs to strong radiant energy since occasional persons may develop untoward reactions or become sensitized in the course of treatment.

Light has been thought to cause or to exacerbate a number of other diseases. Chief among these are pellagra and lupus erythematosus. In the case of pellagra it seems that sunlight simply precipitates the cutaneous lesions while in lupus erythematosus light exacerbates the condition and photosensitization is a feature and not the cause. (Laurens 1938, 1941; Blum 1941a, p. 275; Cipollaro 1940).

As referred to above it has for quite a time seemed evident that there is little danger that people on the whole are getting too little sunshine, but rather that they get too much. This may lead to a number of acute and chronic pathologic conditions. There is wide variation in sensitivity to sunburn radiation among normal persons and a given dose of sunlight or of artificial radiation which produces only a mild degree of erythema and pigmentation in one person may produce severe lesions in another. Very severe cases of acute sunburn following overdosage have been described (Laurens 1933, 1935; Blum 1941a, p. 249). Hausmann (1929, 1930, 1932, see Laurens 1933, p. 515) long ago sounded a warning against the dangers of overindulgence for young and old. He was thinking particularly of the nervous system, of the brain, which he feared might be injured by overexposure with resultant heating of the skull. But he also emphasized that, although the skin may become accustomed to sunlight, its action on certain parts results in a predisposition to certain conditions, e. g., the well known reddening of the chest of women designed by Brocq as "Dermatose du triangle sternoclaviculaire," a *locus minoris resistentiae* for several skin diseases, such as acne, urticaria, eczema, which if not caused directly by the action of radiant energy, are influenced by it. The reddening is sometimes accompanied by pigmentation, telangiectases and thickening of the corneum. There are also the degenerative changes in the skin of aged persons who have been habitually exposed to light. Light is probably a factor in pro-

ducing these changes because the more shaded parts are least affected. (Blum 1941a, p. 252).

#### Bacteria and Other Fungi

Almost all bacteria may be killed or attenuated by the use of ultraviolet rays, but there is considerable variation in the rapidity of their destruction. Those which live in the animal body are most easily affected. Those living free in nature adapt themselves to the action of sunlight and so become relatively resistant to irradiation. Direct sunlight is a powerful germicide for all except a limited number of species like the thio- or sulfur bacteria, which utilize sunlight for metabolic processes (Duggar 1936; Laurens 1933, 1938, 1941; Ellinger 1941).

There is general similarity between absorption curves and the reciprocals of curves for incident bactericidal energy. The curves rise rapidly from low levels beyond 3000 Angstroms to a maximum between 2600 and 2700, then drop to a minimum near 2400 and rise again toward a limit beyond the range of experimental observation. The reciprocal of the bactericidal curves matches the absorption curves of certain nucleoprotein derivatives more closely than those of various amino acids. The curves expressing bactericidal effect are quite similar for all bacteria but some are more sensitive than others. Beginning with the diphtheria bacillus the effect increases for *B. coli*, staphylococci and cholera, culminating with typhus. Tubercle bacilli capable of growth disappear at the earliest in two hours and at the latest in five hours when exposed to sunlight.

The study of the effects of sublethal doses of monochromatic ultraviolet radiation, mostly 2650, on the growth properties of bacteria show that, in general, colonies formed by bacteria which survive irradiation appear somewhat later than colonies formed by the controls: there is a noticeable lag in development, an extended lag phase, but, when the growth curves are followed for a few hours, a second effect becomes apparent, namely, the numbers apparently increase considerably during the first hour or two of incubation, provided that the bacteria have received such quantities of radiation as to yield a fairly low survival, a high percentage killing. Evidence seems to point to the hypothesis that the "apparent initial increase" is a multiplication of cells. There is also the probability that over and above the intracellular products that may determine the normal lag there is doubtless a further addition of inhibiting substances as a result of irradiation (Hollaender and Duggar 1938).

Inactivation data on spores of *Trichophyton mentagrophytes* exposed to measured quantities of monochromatic ultraviolet radiation indicate that 2537 to 2650 Angstroms is the most effective region. It takes approximately  $7 \times 10^4$  ergs to obtain 50 per cent inactivation in these spores as compared with  $8 \times 10^6$  ergs in bacteria (Hollaender and Emmons 1939). In addition to the lethal effect there are others, the most striking being mutant production, which is also greater after exposure in the region between 2537 and 2650. The rate of mutation reaches a maximum, in the particular strain used, at 2650 at an energy level of  $100 \times 10^4$  ergs per spore and rapidly decreases with increasing amounts of energy. Ultraviolet irradiation apparently accelerates the normal rate of mutation. The fact that nucleic acids have their most intense absorption band in this region is significant (Emmons and Hollaender 1939).

Since the killing of living organisms by heat is accompanied by coagulation of protoplasm it is reasonable to suppose that their heat resistance would be decreased by ultraviolet irradiation. This was demonstrated to be true for the spores of three cultures by Curran and Evans (1938). The spores

most easily sensitized are those of high heat resistance. The change produced is apparently irreversible since the tolerance to heat was found to be independent of the time which elapsed between the two treatments.

Toxins as a rule are not very photostable, while antioxins are resistant to the action of ultraviolet energy. A comparison of the effects of ultraviolet on vaccine virus and on *staphylococcus aureus* shows that energy sufficient to inactivate the virus completely kills all the staphylococci. Skin repeatedly exposed to ultraviolet rays is less susceptible to the action of vaccine virus than is nonirradiated skin. The incident energies between 2380 and 3020 Angstroms necessary to kill *staphylococcus aureus* and to inactivate its homologous bacteriophage run strictly parallel, indicating that in the two instances the same organic structures are absorbing the radiations (Gates 1934).

The inactivation of the virus of tobacco mosaic is confined to wavelengths shorter than 3100 Angstroms and the energy required to produce any perceptible effect at this wavelength is more than 100 times that necessary at 2652. The energy values representing 100 per cent killing of *seratia marescens* are far below the values having any measurable effect on the virus. The wavelength of maximum effect is at 2652. The resistance ratio of virus to bacteria is 200:1. In a comparison of the relative resistance of *B. subtilis* (vegetative and spore form) and of *B. megatherium* (spore form) as compared with the resistance of *S. marescens* and the virus of tobacco mosaic to ultraviolet irradiation, the curves for spore and vegetative stages are generally conformable. Some spores (*B. megatherium*) are more resistant than others (*B. subtilis*). The resistance of the virus is so much greater than the resistance of spore stages as to be of a different order of magnitude (Duggar and Hollaender 1934). Ultraviolet radiation inactivates "pure" bacteriophage of several kinds of bacteria and there are numerous factors which influence the efficiency of this inactivation (Kendall and Colwell 1940).

Bacteria, bacteriophages and viruses are readily sensitized by photodynamic substances. In the deleterious effect of the photodynamic action of dyes on antibodies the antibody protein remains completely soluble in saline and its relative viscosity is not apparently changed (Zia et al. 1938). Several dyes are lethal as photodynamic agents for gram-positive organisms but not for gram-negative. Safranine is, however, along with low native bactericidal power. Hydrogen peroxide enhances its photosensitizing action (T'ung 1938). Methylene blue in the presence of light destroys anti-pneumococcal serum. Neutralization of diphtheria toxin by antitoxin is inhibited after an exposure of a mixture of antitoxin and methylene blue to light (Ross 1938). Erythrosin and dizyanin-A sensitize bacteria to long wave luminous energy and to the infra-red (Liechti et al. 1939). Diphtheria toxin is destroyed by ultraviolet irradiation and can be sensitized to light. Tetanus toxin keeps less well in light than in the dark and can be shown to be inactivated by ultraviolet rays and by light when photodynamically sensitized. Ultraviolet radiation (2537) may be so applied to tubercle bacilli that they are rendered nonvirulent without being made nonviable, and the irradiated viable tubercle bacilli may induce demonstrable immunity in experimental animals. Organisms killed by the radiation do not induce measurable immunity (Smithburn and Lavin 1939). Greater immunity to infection was assured by injection of a streptococcus vaccine prepared by ultraviolet irradiation than by one which had been heat-killed. The former appeared less toxic for intradermal tests and experimental animals showed less local redness and swelling (Murray 1939). The Shope papilloma virus loses virulence

but retains antigenicity under ultraviolet irradiation (Woglorz and Warren 1939). Irradiation with ultraviolet rays has been shown to render neurotropic viruses avirulent with accompanying loss of immunizing potency. But when properly exposed to ultraviolet radiation rabies virus loses virulence but retains considerable immunizing potency (Hodes, Webster and Lavin 1940). The infectivity of the virus of epidemic influenza is destroyed by exposure to ultraviolet radiation but the virus is still capable of inducing an immune response (Salk, Lavin and Francis 1940). Exposure to ultraviolet rays inactivates poliomyelitis virus (Schultz 1932; Toomey 1937).

Interest continues keen in the possibility of sterilization of the air in wards and operating rooms by means of radiation (Hasche 1940; Sharp 1940; McCord 1941; del Mundo and McKhann 1941; Greene et al. 1941; Wells and Lurie 1941; Hart 1941; Hirshfeld 1941). The physical factors concerned in bactericidal irradiation of air have been set forth in detail (Wells 1940), as well as the bacteriologic and epidemiologic factors in infection of air (Wells, Wells and Mudd 1939). Air is an important source of contamination in every operative wound and sterilization of the air can be accomplished by bactericidal irradiation. The majority of the pathogenic bacteria are staphylococci which cause over 90 per cent of wound infections. Post-operative wound infections have been reduced more than 85 per cent as well as the incidence of postoperative pyrexia. Wounds exposed to an appropriate intensity of radiation heal better, there is less risk of infection and less systemic and local reaction than in wounds not so irradiated (Hart 1940, 1941; Overholt and Betts 1940; Kaissl et al. 1940). Barriers of ultraviolet rays are effective in preventing the spread of infection in isolation wards and of artificially introduced bacteria from cubicle to cubicle. The effect is great when air movement is slow and less so when rapid. Either air-conditioning or ultraviolet lamps markedly reduce the number of airborne bacteria; ultraviolet is the more effective (Robertson et al. 1939, 1940; Barenberg et al. 1940).

### Protozoa

The lethal effect on *Paramecium micromultinucleata* increases rapidly for wavelengths shorter than 3000 Angstroms and reaches a maximum at 2650 from which it diminishes for shorter wavelengths. According to Giese and Leighton (1935) 2654, 2804 and 3025 are about equally effective and 2537 is less efficient. Swann and del Rosario (1932) found that 2536 and 2894 killed Euglena readily, while 3132 and 3654 had practically no effect.

Each species of a number of protozoans was found to have a characteristic resistance to ultraviolet radiation (2537 Angstroms). The most susceptible form extinguished the most energy per unit area. Changes in resistance were due primarily to altered physiologic state and secondly to small variations in environment (Giese 1938a, 1939). Wavelengths of 3130 and 3660 had no visible effect in large doses on protozoa but when the dosage with 3130 was sufficiently great the encystment time of *Colpoda* was increased (Giese 1938b). Cell division in *Paramecia* was more retarded by irradiation at 2804 than at 2654, but recovery was more rapid, presumably due to the fact that the injury at 2804 was localized in the cytoplasm which was more readily repaired than was injury to the nucleus by irradiation at 2654 (Giese 1938a, 1939).

### Proteins

Irradiation of solutions of proteins produces several effects, including shift in H ion concentration, denaturation, coagulation and increased filtering capacity for ultraviolet rays between 4000 and 2670 (Clark 1936; Arnow

1936). The coagulation of isoelectric egg albumin solutions on exposure to ultraviolet rays involves three processes: (1) light denaturation of the molecule, (2) a reaction between the light denatured molecule and water, and (3) flocculation on moderate heating of the denatured molecules to form a coagulum (Clark 1935).

Secondary protein derivatives, which can be dialyzed at pH 4.8, are formed by the ultraviolet irradiation of egg albumin at 25 C. They are probably the result of a breaking of the polypeptide chain. The weights of ovalbumin precipitated at the isoelectric point after irradiation indicate that the formation of denatured protein, and of soluble protein derivatives from the denatured protein, are first-order processes. Oxygen does not influence the denaturation process but increases the formation of soluble protein derivatives. Denaturation and molecular splitting are due to different processes (Bernhart 1939). Evidence suggests that ultraviolet irradiation causes the liberation of material of low molecular weight which, together with albumin residues, undergo photooxidation reactions which result in increased light absorption (Sanigar et al. 1939). The ultraviolet absorption spectra of several purified plant viruses indicate that they contain nucleic acid (Lavin et al. 1939).

#### Mode of Action

The denaturation of the protein molecule by ultraviolet radiation has long been considered to be a fundamental effect which may lie at the bottom of many more complex radiation changes. But the nature of the initial light denaturation which precedes coagulation is as yet unknown (Clark 1939).

The setting free, or the elaboration of histamine or of H-substances, is involved in many effects (Laurens 1941). Radiations produce colloid chemical changes, in living cells as in proteins—aggregation, change in solubility, increased viscosity and coagulation. Increase in fluorescence, as a result of the appearance of photooxidation products, indicates that the primary effect is a structural and chemical change. The increase in fluorescence is proportional to the amount of available oxygen. Final coagulation is the fundamental process in the inhibition of cell division caused by irradiation. An increase in fluorescence occurs in the nucleolus, and in the network of the nucleus. There is something here fundamental to the production of mutations. In the photochemical changes indicated by increase in fluorescence we have the primary process of ray action, on which coagulation follows when the photochemical change reaches such a degree that the solubility properties of the protein constituents change. The change in chemical structure is intramolecular, following immediately on absorption in individual molecules and is independent of environment. Flocculation, which follows the chemical change, is dependent on environment.

Sulphydryl groups occur in considerable amounts in the germinal layer of the skin and account for its strong reducing power. The catalytic action of radiant energy is concerned with reduction processes and the shorter ultraviolet wavelengths are more effective than long and these than luminous rays. The intrinsic protective and healing processes of the skin are based on its richness in SH groups. This is the function of the rich supply of sulfur in the skin. The sulfur is heaped up in the form of SH groups, accessible to the body in fluid exchange and accessible to the action of radiant energy and thus, owing to the catalytic action of the latter, carrying out important functions with greatly accelerated velocity. Radiation may not only catalyze the reducing action of already present SH groups but also form new SH groups and thus the photochemical formation of active sub-

stances, such as vitamin D, sex and adrenal cortex hormones, the carcinogens, aldehydes and adenylic acid. Sulfhydryl groupings enter into antigenic specificity and enzyme destruction by ultraviolet energy.

Here as in so many instances, the observed facts and their application in explaining others have far outstripped the understanding of the mechanisms by which the observed facts or findings are obtained. In irradiated tissues atoms and molecules are ionized or activated. These may lead to chemical, colloidal, changes in the molecules and thus cause the observed effects. Physiologic effects have their origin in photochemical reactions produced when the energy is absorbed. The effect is physical, chemical, and finally biological. The underlying mechanisms of the effects of radiation are obviously quite different from those observed and the fundamental processes are in great measure unknown. What we would like to know more about is, on what part of the living cell does the radiation act and what is the primary change, and as to how the observed final action follows the primary effect. The end results must be due to changes in the organic substances of the cell and their molecular organization, or to changes in cell physiology or cell structure (Clark 1939). A recent suggestion (Wiebe 1940) is that the primary process consists in changes in or destruction of controlling centers, or regions of greater sensitivity, in the cells, e.g., the nucleus. The development of this concept of action on a controlling center has led to a so-called Impact (Treffer) Theory, based on the quantal nature of radiation. Manifest effects are due to mutations in the individual cells, resulting from the absorption of quanta of energy by the chromosomes or genes. These mutations give rise to the variety of observed effects.

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# ARCHIVES of PHYSICAL THERAPY

OFFICIAL PUBLICATION AMERICAN CONGRESS OF PHYSICAL THERAPY

## . . . EDITORIALS . . .

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### MILESTONES IN ACTINIC THERAPY

It is less than half a century since the immortal Finsen's epoch making work, "Medical Employment of Concentrated Chemical Rays of Light" appeared. His clinical and laboratory studies brought recovery to thousands of victims of lupus vulgaris and became a powerful impetus for the therapeutic employment of artificial sunlight containing a predominance of ultraviolet radiation. American physicists and physicians took from the very start important roles in the development of this new treatment agent. Peter Cooper Hewitt of New York manufactured the first mercury vapor lamp in 1901, after its discovery by Arons in 1892. Huldschinsky of Berlin first published a statement in 1919 that irradiation of a rachitic child with ultraviolet rays would bring about a cure, but it was the simultaneous painstaking clinical and experimental work of the New York physician Hess and his co-workers, who within a few years, established the chemical mechanism of this process and developed the dosage factors of treatment. The next important advance was the experimental work of Steenbock of Wisconsin in 1923 that such antirachitic agents as ultraviolet rays and codliver oil would restore the growth of rats maintained on a diet deficient in the fat soluble vitamins. This led not only to the recognition of vitamins A and D, but also to the widespread utilization of the antirachitic potency of irradiated foodstuffs. Some of the extensive laboratory research stimulated by these discoveries is now being directed towards the problem of formation of other vitamins by photosynthesis.

The physiologic and clinical effects of ultraviolet other than antirachitic have received an enormous amount of study in the recent decades and the comprehensive summary of these by Laurens<sup>1</sup> in this issue comes from one who himself has carried on brilliant work of a wide scope in the field of radiant energy. In the evaluation and measurement of the bewildering variety of sources of ultraviolet and infra-red rays, the National Bureau of Standards, under the spirited leadership of Dr. W. W. Coblenz, has carried on internationally recognized work. This has enormously helped to clarify and safeguard the physical aspects of therapeutic radiation and Coblenz's study on the hazards of burns from artificial ultraviolet applicators<sup>2</sup> appearing in this issue is one of many similar ones of definite practical importance.

The bactericidal action of light on a mixture of organisms encountered in putrefying substances has been discovered as early as 1872 by Downes and Blunt.<sup>3</sup> When Finsen treated skin tuberculosis with the "cold" ultraviolet rays of his carbon arc lamp he was of the opinion that the results were due to the bactericidal action on tuberculosis germs in the depth of the skin. We know now that the penetration of ultraviolet is restricted to the uppermost layers of the skin—two millimeters or less—and the principal factor in Finsen therapy was the well localized inflammatory reaction. Only in comparatively recent times was it shown that the maximum bactericidal effect of ultraviolet is in the spectral zone of between 2,960 and 2,100 angstroms

and that generators emitting an almost monochromatic radiation of 2,537 angstroms can be successfully employed for surface sterilization of foods, certain pharmaceutical products and the air. Wells<sup>4</sup> carried on pathfinding studies on air sterilization beginning in 1936, which led to those of Hart,<sup>5</sup> Robertson<sup>6</sup> and others. Today radical diminution of air-borne infection in operating rooms and the production of barriers of ultraviolet rays for the prevention of cross infection in hospital rooms are an established fact. Studies of the mechanism of the lethal action of actinic radiation holds out further hope for newer methods of attack on some unsolved problems of physiology and pathology.

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### THE ANNUAL CONGRESS ON MEDICAL EDUCATION \*

The annual meeting of the Congress on Medical Education, conducted under the auspices of the Council on Medical Education and Hospitals of the American Medical Association, was held in Chicago February 16 and 17. Much interesting information was presented in regard to the problems of education as related to the war effort.

Colonel Lull of the Office of the Surgeon General of the Army reported that 11,790 physicians are now on duty in the Army Medical Corps and that for 1942, the Army would need 23,658 physicians. This indicates that many vacancies are yet to be filled during the coming year. It is estimated that about 5,000 students will be graduated from our medical schools each year, and that about 3,000 of these will be fit for military duty. At present, approximately 30,000 physicians less than thirty-five years of age are available for military service. At the close of the World War of 1914 to 1918, approximately 31,000 physicians were on duty in the Army. There is every indication that a large job must be done by the physicians of this country.

Admiral McIntyre, Surgeon General of the Navy, suggested that the present length of training for physicians is too long. He expressed the belief that it might be possible to combine medical and premedical courses and thus lessen the period of training. He was of the opinion that medical schools should pay more attention to the cultural aspects of medical education. He also advocated a more uniform method of giving premedical courses and urged that more attention be paid to the subject of preventive medicine. Admiral McIntyre pointed out that at present, the Navy could see its way clear in the procurement of physicians, nurses, dentists and corpsmen, and that no difficulty is anticipated in obtaining proper personnel in the Medical Corps of the Navy. Admiral McIntyre gave high praise to Reserve Officers in the Medical Corps of the Navy and stated that with

\* Submitted for publication March 3, 1942.

a ratio of two Reserve Officers to every one Regular Officer the Medical Corps of the Navy was functioning in a highly efficient manner.

The discussions of Admiral McIntyre and Colonel Lull gave point to the statement of General Parran, Surgeon General of the Public Health Service, that this is a total war and that complete co-operation of every physician will be needed. General Parran pointed out that it would be necessary to use the services of every qualified physician to the limit of his ability in the field in which he was trained. General Parran stated that great new responsibility had been placed on his service, owing to the vast shifts of population to new industrial centers. Approximately 1,000 more public health physicians are now needed.

Colonel Rountree, Medical Advisor to the Selective Service Headquarters in Washington, D. C., outlined the problems with regard to the deferment of medical students in order that an uninterrupted stream of physicians might continue to pour into the ranks of the Army and Navy Medical Corps.

Dr. Irving Abell, of the American Medical Association, discussed the survey of the medical profession and stated that the status of 184,000 physicians had been studied and that their qualifications had been listed so that they could receive appropriate assignment in case they were needed in the military services. He mentioned that approximately 62,000 physicians were less than forty-five years of age, 41 per cent of whom were listed as general practitioners. A high percentage of these men will be needed for military services. Dr. Diehl, Dean of Medical Sciences at the University of Minnesota, explained that the plan for accelerating the teaching of medical students during the next three years would provide 12,500 physician-years of service. He recommended that medical schools ask only for the deferment of truly essential teachers.

Physicians interested in physical therapy will be pleased to know that all men who style themselves as specialists in this field have been recognized and their records segregated in the punch card system of the American Medical Association so that they will be available in case they are needed for military service. Likewise of interest to those who specialize in physical therapy will be the news of the luncheon given for the deans of various medical schools by the Council on Physical Therapy of the American Medical Association during the meeting of the Congress on Medical Education. At this meeting, Dr. Eben Carey, Dean of the medical school of Marquette University, made an urgent plea for the establishment of courses in physical therapy in all undergraduate medical schools. He pointed out that with development of the present military emergency and with the need for physical rehabilitation of many wounded and injured soldiers and sailors, there would be a great demand for physicians trained in physical therapy. Dr. Harry Mock, Chairman of the Council on Physical Therapy, also spoke, as did other members of the Council on Physical Therapy. Dr. Carey's talk was well received by the various deans who attended the luncheon and there is reason to believe that a number of schools which did not previously offer courses in physical therapy to undergraduate medical students will now plan to include such courses.

There was much which transpired at the congress to indicate that physical therapy is receiving more and more attention from medical educators. It is to be hoped that physical therapy will continue its forward advance with much greater acceleration during the trying years which now confront us.

### THE SPRING SESSIONS

Full page announcements appear in this issue of the programs of the spring meetings of the Eastern and Midwestern Sections of the American Congress of Physical Therapy. There was never a time like the present one when it was more desirable to increase our knowledge for rendering better service in our chosen field and to receive the mental stimulus of rubbing elbows with the "other fellow." The regional meetings of the Congress are for many years splendidly serving their purpose to assemble members of the adjoining states for a day of practical discussions and for visiting each other's "work shops" and the two programs offered here should fully live up to the standards previously established.

The Eastern Section will meet on Saturday, April 11, in the imposing Amphitheatre of Jefferson Medical College at Philadelphia, where Dr. William H. Schmidt will be again genial host as on previous occasions. The subjects to be presented under the chairmanship of Dr. Madge C. L. McGuinness are timely and of practical interest and are to be discussed by outstanding teachers and clinicians. It is hoped that fellows from Pennsylvania, New York, New Jersey and Connecticut as well as from Maryland and the District of Columbia will attend in full numbers and bring their medical friends and technicians.

The Midwestern Section will meet on Monday, April 6, at the University of Iowa Hospital Medical Amphitheatre, Iowa City, under the chairmanship of Dr. William D. Paul. Six papers of special interest are to be presented by well known clinicians; interestingly enough the up-to-date subject of hypothermic anesthesia in extremity surgery appears on the program of both Eastern and Midwestern Sections. Last year's meeting of the Midwestern Section at Madison was a most successful event and it will undoubtedly stimulate fellows from Iowa, Illinois, Indiana, Wisconsin, Minnesota, Nebraska and Kansas to gather for half a day at the seat of learning between the banks of the Iowa River.

### Physiologic Effects of Radiant Energy — Laurens

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# MEDICAL NEWS

## Drs. Piersol and Bowie New Members of the Council on Physical Therapy

In the Journal of the American Medical Association it is announced that by its action the Board of Trustees of the American Medical Association has appointed to serve on the Council of Physical Therapy Dr. George M. Piersol of Philadelphia and Dr. M. A. Bowie of Bryn Mawr, Pa., to succeed Dr. Harry E. Mock and Dr. Ralph Pemberton. Dr. A. C. Cipollaro whose term expired February, 1942, was reappointed.

## Civilian Defense

The Office of Civilian Defense, Washington, D. C., has divided for administrative purposes, the United States into 9 regions closely corresponding to the Corps areas of the United States Army. The Sixth Civilian Defense Region consists of the States of Illinois, Michigan, Wisconsin and the Chicago Metropolitan Area. Dr. John S. Coulter has been appointed a part-time consultant in the United States Public Health Service and the Regional Medical Officer of the Sixth Civilian Defense Region with offices at 20 North Wacker Drive, Chicago.

## Dr. Coulter Member of Chicago Emergency Medical Service

The Emergency Medical Service of the Office of Civilian Defense for the Chicago Metropolitan Area has completed its organization and now is functioning, Mayor Edward J. Kelly of Chicago, Metropolitan Coordinator, has announced. Dr. Herman N. Bundesen is chief of Emergency Medical Service and chairman of the Executive Committee of the Medical Advisory Council. Dr. Morris Fishbein is vice-chairman of the Executive Committee. Other members are Dr. Raymond B. Allen, Dr. John S. Coulter, Mr. Joseph H. King and Dr. Malcolm T. MacEachern.

## Dr. Seymour Takes on New Responsibilities

Dr. W. B. Seymour of Cleveland has recently been named Assistant Director of Lakeside Hospital. For some time, Dr. Seymour has been in charge of the Department of Physical Therapy at the University Hospitals.

## Duke of Gloucester Congratulates Copeman

British Embassy,  
Washington, D. C.  
24th February, 1942.

Executive Secretary, American Congress of Physical Therapy, 30 North Michigan Avenue, Chicago, Ill.

Dear Sir:

With further reference to your letter of November 4th last, I am to inform you Lieutenant Colonel

W. S. C. Copeman, R. A. M. C., who was advised by this Embassy of the award to him of the Gold Key of Merit by the American Congress of Physical Therapy, has asked me to convey to the Congress an expression of his gratification and pleasure at this award. Dr. Copeman adds that it may interest the Congress to know that His Royal Highness the Duke of Gloucester, on hearing of this award, wrote personally to him in congratulation, expressing his pleasure at this sign of Anglo-American scientific unity.

Yours very truly,

F. R. HOYER MILLAR.

## Session on Physical Therapy The Medical Society of the State of New York

Wednesday, April 29th, 1942, 2 p.m.  
Waldorf-Astoria, Ballroom.  
Chairman — *Madge C. L. McGuinness*, M.D., New York.

Secretary — *Harold J. Harris*, M.D., Westport.  
Address: Physical Medicine in War and Defense.  
*Madge C. L. McGuinness*, M.D., New York.

### 1. Physical Therapy in Heart Disease (lantern slides).

*William G. Leaman, Jr.*, M.D., Assistant Professor of Medicine, in Charge, Department of Cardiology, Women's Medical College of Pennsylvania.

Discussion: *Walter S. McClellan*, M.D., Saratoga Springs, N. Y.; *Washington Merscher*, M.D., Watkins Glen, N. Y.; *Franz Groedel*, M.D., New York, N. Y.

### 2. Functional Disorders of the Foot and Their Treatment.

*Dudley J. Morton*, M.D., Associate Professor, Anatomy, Columbia University; Research Associate, American Museum of Natural History, New York, N. Y.

Discussion: *Herbert C. Fett*, M.D., Brooklyn, N. Y.; *Paul N. Judson*, M.D., Philadelphia.

### 3. War Experiences Abroad and at Home.

*Philip D. Wilson*, M.D., Medical Director, American Hospital in Britain; Surgeon-in-Chief, Hospital for the Ruptured and Crippled, New York.

Discussion: Captain *C. S. Stephenson* (MC) U. S. Navy, in Charge Division of Preventive Medicine; Lieut. Com. *Harold J. Harris*, M.D. (MC) U. S. Navy, Senior Medical Officer; Lieut. Col. *Norman E. Titus*, M.D., (MC) New York, N. Y.

### 4. The Technic of the Kenny Treatment in Acute Poliomyelitis.

Sister *Elizabeth Kenny* of Australia.

Discussion: *Philip M. Stimson*, M.D., New York, N. Y.; *Walter I. Galland*, M.D., New York, N. Y.

### Infantile Paralysis Discussed at Recent Meeting of Academy of Orthopaedic Surgeons.

At the tenth annual convention of the American Academy of Orthopaedic Surgeons held recently in Atlantic City, N. J., the following papers were presented on infantile paralysis:

Dr. Robert L. Carroll, of Los Angeles, "Rate and Amount of Increase in Muscle Strength Following Infantile Paralysis"; Dr. Wallace H. Cole, of St. Paul, "Further Report on the Kenny Treatment of Infantile Paralysis."

### Meeting of the Joint Council of Pathologists, Radiologists, Anaesthesiologists and Physical Therapy Physicians

A meeting of the members of the Joint Council of Pathologists, Radiologists, Anaesthesiologists and Physical Therapy Physicians was held at the Hotel Commodore, New York, N. Y., Friday evening, February 27th, 1942.

The following matters were discussed: The Radiology Bill, the Physical Therapy Bill, and the A. M. A. Resolution Concerning the Four Specialties.

M. J. FEIN, M.D., Chairman.  
M. C. L. McGuINNESS, M.D., Secretary.

### Council Approval for Emergency Course

For the duration of the emergency the Council on Medical Education and Hospitals has extended its approval for the emergency course for physical therapy technicians offered by Harvard Medical School.

### Meetings of the Section of Physical Medicine of the Royal Society of Medicine

The first meeting of the 1941-1942 session of the Section of Physical Medicine of the Royal Society of Medicine took place on Saturday, October 4, 1941, at Oxford, under the presidency of Major G. D. Kersley, R.A.M.C. Well over 100 members and guests were present.

In the morning there was a demonstration of cases of Spondylitis Ankylopoetica by Dr. Basil Kiernander at the Wingfield Morris Hospital, showing the effects of the application of physical treatment for the condition. Following this there was a demonstration by Dr. Guttman of sweat secretion tests and by Dr. Weddell of muscle potential.

In the afternoon there was a meeting in the Radcliffe Infirmary at which Lieutenant Commander Bunyan, R.N.V.R., gave a demonstration of cases together with a film on the treatment of burns with electrolytic sodium hypochlorite; this was discussed by Dr. Turrell and Professor

Stefan Jellinek. A demonstration of electrically induced convulsion was given by Lieutenant Colonel Armstrong, after which there was a conducted tour of the Radcliffe Infirmary while on the following day there was a conducted tour of the Wingfield Morris Hospital.

The second meeting of the Section was held at Bath on Saturday, November 1, 1941. Thirty-two members and guests were present. In the morning there was a demonstration of clinical cases by members of the medical staff at the Royal National Hospital for Rheumatic Diseases. Mr. J. Bastow demonstrated 6 cases of ankylosing spondylitis, showing the effects of progressive plasters and exercises. He also showed cases of rheumatoid arthritis of the knee treated by, (a) lavage, (b) bone drilling (c) rest plasters. Dr. Barnes Burt showed a case of gout (tophaceous), a case of rheumatoid arthritis of the hips with large cysts in the iliac bones; he also showed a number of patients with rheumatoid arthritis who had had numbers of courses of gold over a long period. The President, Major Kersley, demonstrated a case of chronic gout. Dr. H. J. Gibson demonstrated pathologic specimens and also "Spa Hospitals' Method" of estimating the blood sedimentation rate.

In the afternoon there was a demonstration of hydrotherapy at the Royal Baths, followed by a discussion on "The Value of Hydrotherapy in Rehabilitation," opened by Dr. Geoffrey Holmes and Colonel R. G. Gordon, R.A.M.S. (This interesting report by our good friend Dr. F. H. Humphris of London shows how our British colleagues are carrying on their special meetings during the war. They take off a day each month to meet within an hour or two from London, in one of the spas, which have become centers for rehabilitation for many conditions.—Ed.)

### New York Physical Therapy Society

The New York Physical Therapy Society will hold a stated meeting, March 4, 1942, at 8:30 p. m., in the Gymnasium, fourth floor, Administration Building of the Mount Sinai Hospital, New York, N. Y. The following program will be presented:

New Instruments (illustrated with motion pictures, lantern slides and apparatus). (a) A Support for the Technician Administering Underwater Exercise in a Tank; (b) A Suction Surgical Electrode. William Bierman, M.D.; (c) A Galvanic Current Electrode. A. W. Schenker, M.D.

Scientific Session. Papers of the evening. (1) A Decade of Fever Therapy. William Bierman, M.D. (2) Treatment of Backache. A New Approach. Illustrated with lantern slides and apparatus. A. W. Schenker, M.D. Discussion opened by Josephine L. Rathbone, Ph.D.



## BOOK REVIEWS

DIE GOLDBEHANDLUNG DER CHRONISCHEN ARTHRITIS UNTER BESONDERER BERUECKSICHTIGUNG DER KOMPLIKATIONEN. By *Fredrik Sundelin*. Acta medica Scandinavica, Supplementum CXVII. Paper. Pp. 291. Lund: Håkan Ohlssons Boktryckeri, 1941.

Gold therapy for rheumatoid arthritis has been attracting increasing attention in America during the past five years, and, although this form of treatment has proved distinctly dangerous, a number of outstanding rheumatologists have stated that the results obtainable justify the risks. Gold, therefore, doubtlessly will receive wide clinical trial in this country during the coming years and Sundelin's splendid monograph certainly will prove of great value to physicians using this form of treatment.

The volume, as its title suggests, deals largely with the toxic complications of aurotherapy. It comprises two large sections, the first of which outlines the history of aurotherapy and reviews in considerable detail the literature relating to toxicity of gold. The second section relates the author's experiences with the untoward effects of gold. His observations are based on careful study of 1095 courses of gold therapy in 730 cases of various forms of chronic arthritis. The work is documented with 814 references and represents the most extensive analysis of the subject ever written. It is a storehouse of information.

Lande and Pick are credited with the first reports on the value of gold in treatment of chronic rheumatism rather than Forestier, who generally receives this honor in American papers.

The records reveal that the incidence of toxic reaction has been less with small doses of gold; on the other hand, serious reactions have occurred even when the doses were minute. In some instances, however, reactions were not observed when the patients were given as much as 30 Gm. of a gold salt, nearly ten times the usual amount administered at present. It is stated that the therapeutic effectiveness of gold is not dependent on its bactericidal effect but appears to rest on some subtle influence exerted on humoral resistance.

Sundelin's summary of the therapeutic claims previously advanced regarding gold therapy in arthritis indicates the basically unsound character of these reports. Lack of uniformity in designating diseases studied, lack of controls, lack of critical judgment and a wide variance of claims have distinguished this chapter in the literature of rheumatism therapy—the same faults which have dogged so many previous episodes. The detailed analysis of previously reported reactions to gold therapy is critical, exhaustive and interesting.

Introducing the second section relating to his personal experiences with gold, Sundelin noted that he had included not only cases of rheumatoid arthritis

but also cases of specific arthritis, rheumatic fever, posttraumatic and chronic arthritis, spondylitis, arthritis with psoriasis and scleroderma and even two cases of gout. Unfortunately, however, the relevant material on toxicity is not considered in relation to these various diagnoses.

The author's experiences again emphasize the danger of gold therapy. Of the 730 patients treated, six died, a mortality rate of approximately 0.8 per cent; this figure is large. No instances of serious renal or hepatic damage were encountered, although both these toxic reactions had been reported previously with notable frequency. Eosinophilia, previously designated as a warning sign of impending toxic reactions, was found to be useless for this purpose. In most instances, eosinophilia did not appear until the toxic reaction was full blown. Complications involving the nervous system were more numerous than in previous series, amounting to 11 per cent of all reactions noted. Two of these reactions involving the nervous system proved fatal; reports of necropsy on the brains are included.

The book contains many useful tables in which the author has summarized much important material. The work deserves high praise and represents a noteworthy addition to the literature on therapy of chronic arthritis.

OCCUPATIONAL DISEASES: DIAGNOSIS, MEDICOLEGAL ASPECTS AND TREATMENT. By *Rutherford T. Johnstone*, A.B., M.D., Director of the Department of Occupational Diseases, Golden State Hospital, Los Angeles, California; Formerly Assistant Professor of Medicine, University of Pittsburgh School of Medicine. Cloth. Price, \$7.50. Pp. 558. Illustrated. Philadelphia and London: W. B. Saunders Company, 1941.

This volume deserves to be reviewed on a basis of something more than a treatise on occupational diseases. It includes much other valuable material. The first section, for instance, is divided into three chapters: (1) the purpose of workmen's compensation act, (2) the administration of the workmen's compensation act and methods of evaluating disability and (3) the function of the physician in relation to the workmen's compensation act. Following there are a series of chapters, twenty-two in all, covering the various poisonous and irritating gases, solvents and fumes and the metals. Each of the groups is covered from the standpoint of the occupational hazard if exposure is present, the symptomatology, pathology, diagnosis and treatment. In addition, the medicolegal aspects of such exposure are discussed in detail and case histories are given. The various types of dust hazard—silicosis, anthracosilicosis, asbestosis and the inert dusts—cover four chapters and are similarly presented. Other chapters deal with the industrial back and compensable

hernia, occupational dermatoses, occupational cancer, heat and climatic affections, electrical injuries and caisson diseases; medicolegal aspect of trauma and its relation to the production of disease and the production of neurosis and malingering; the value and technic of preemployment examinations. An appendix is included which gives a table of toxic thresholds of common industrial substances. Each chapter has a comprehensive and up-to-date bibliography. The reviewer knows of no single volume that gives as comprehensive articles on the aspects of the relation of pathology to occupation. The illustrations are well chosen and reproduced. There is a complete subject index.

**MANUAL OF CLINICAL CHEMISTRY.** By Miriam Reiner, M.Sc., Assistant Chemist to the Mount Sinai Hospital, New York. With an Introduction by Harry Sobotka, Ph.D., Chemist to the Mount Sinai Hospital, New York. Cloth. Pp. 296 with 18 illustrations. Price, \$3.00. New York: Interscience Publishers, Inc., 1941.

To that uncounted but vast number of internes and even laboratory technicians throughout the English speaking lands this brochure will be most welcomed as a timely, practical and authoritative work. It should become the most thumbed manual on clinical chemistry, because it presents in clear, direct and abbreviated style directions that often as not are emergency analyses for the accurate determination of blood sugar, urea, carbon dioxide content and the like. Initiated in the form of laboratory sheets for internes, it developed into the more formal stage of syllabus, and because of its marked success evolved into its present bookform state. Its legitimacy as a permanent contribution has therefore been honorably achieved, and for this service unstinted credit goes to the assistant chemist of the Mount Sinai Hospital of New York, and honorable mention to her chief for aid and encouragement in a task that is bound to mitigate the trying labors of many novitiae in medicine. As pointed out by Sobotka in his introduction, its purpose "is to give at least one method each for every contingency, and it has been attempted to select those methods which combine greatest accuracy with greatest simplicity"—methods which have been found satisfactory and reliable by the Mount Sinai Hospital laboratory and clinical staffs through more than twelve years of experience. Often the methods selected for routine use were dictated by economy, convenience and availability of reagents and by intangible factors classified under the heading of utilitarian necessity. Thus the work expanded into its present format by trial and organization and by correlations between routine analysis and clinical observation. In the space of twelve chapters, including an index of subjects and authors, Reiner has managed to pack these pages with such voluminous material for chemical testing of blood and the assaying of certain chemotherapeutic (sulfanilamid in blood and urine) products as well as the related problems associated with vitamins, antigens, hormones, toxicological and functional tests and the like, that the information assumes the scope of an encyclopedia in abbreviated form. Here is a must book for

students of biochemistry, internes in need of authoritative guidance and for laboratory technicians in search of direct and reliable methods of clinical chemistry. As a parenthetical but constructive thought it may be timely to suggest the better rounding out of this thesis by including in a future edition greater exposition to necessary quantitative analyses often associated with or complimenting emergency laboratory procedures.

**TREATMENT OF THE PATIENT PAST FIFTY.** By Ernst P. Boas, M.D., Associate Physician, Mount Sinai Hospital, New York City; Chairman, Committee on Chronic Illness, Welfare Council of New York City; Assistant Clinical Professor of Medicine, Columbia University. Pp. 324, with 19 illustrations and 4 tables. Price, \$4.00. Chicago: The Year Book Publishers, Inc., 1942.

A change in the complexion of disease has come about in the beginning of the twentieth century, for according to the revelation of successive census reports there is a thirty-six per cent increase in the elderly among America's population in the last decade alone; this is due to two chief causes, one, a marked fall in the birthrate and the other the sharp drop in the migration of young adults. The large number of aged persons seeking to keep well, makes the early diagnosis and appropriate methods of treatment of chronic diseases and the means of disease prevention in the elderly more and more important. The author of this volume correctly points out that the practicing physician must become the chief agent of preventive medicine in the field of chronic diseases, as the middle aged and the aged make up a steadily increasing proportion of his practice. The control of diabetes, heart disease, and chronic rheumatism depends on an alert medical profession as well as on the public being educated to be on the lookout for early symptoms. Out of his own rich experience in the actual treatment as well as in the sociologic consideration of chronic disease the author has produced a stimulating volume enabling the special approach required for successful treatment of the aged. The first four chapters are devoted to the general considerations and to the management of the aged and of aged persons; the next four apply to diseases of the cardiovascular system and these are followed by chapters on diseases of the lungs, of the gastrointestinal tract, of the liver, bile passages, pancreas, of the genito-urinary tract and of diseases of the bones, joints and gout. The final chapters relate to infectious diseases, diabetes, diseases of the thyroid gland, of the eyes, of the skin and of the nervous system. The author consistently emphasizes that treatment of the sick person and not of the disease is one that counts. Among the measures necessary to manage successfully rheumatic and kindred conditions physical measures are correctly pointed out, but perhaps owing to the necessity for brevity, no detailed instructions for their application are given, similar to those so well presented regarding administration of diet and other supporting treatments. There are a number of good illustrations and tables and the typography of the book is of the usual high standard of the publishers. Every practitioner of medicine who now

deals with increasingly larger numbers of old age groups will derive much useful information from this timely volume.

**FRACTURES AND OTHER BONE AND JOINT INJURIES.** By *R. Watson-Jones*, B.Sc., M.Ch.Orth. F.R.C.S.; Civilian Consultant in Orthopedic Surgery of the Royal Air Force, Member of War Wounds Committee of Medical Research Council; Member of British Medical Association Committee on Fractures; Member of Council and Chairman of Standing Committee on Fractures of the British Orthopedic Association; Lecturer in Orthopedic Pathology, Lecturer in Clinical Orthopedic Surgery, and Secretary of the Board of Orthopedic Studies, University of Liverpool; Neurological Surgeon to Special Head and Spinal Center, Emergency Medical Service; Honorary Orthopaedic Surgeon, Royal Liverpool United Hospital; Visiting Surgeon, Robert Jones and Agnes Hunt Orthopaedic Hospital; Consulting Orthopaedic Surgeon, Royal Lancaster Infirmary, North Wales Sanatorium, Birkenhead, Hoylake and West Kirby, Wrexham and East Denbighshire and Garston Hospitals. Second Edition, Cloth. Pp. 724 with 1,040 illustrations. Price, \$13.50. Baltimore: The Williams and Wilkins Company, 1941.

This is a splendid book on fractures and joint injuries. Every subject is thoroughly covered and there are many fine illustrations. It presents much material of interest to those interested in physical therapy. The chapter on adhesions and joint stiffness should be read by every physician in charge of a physical therapy department. The author gives numerous practical hints on how to prevent stiffness of joints despite the complete fixation of the fracture. He gives a thorough discussion of the causes of adhesions and joint stiffness, that is, functional inactivity and disuse, circulating stasis and waterlogging of the tissues with sero-fibrinous fluid; joint injury—traumatic capsule or from a neighboring fracture, a source of recurrent exudation if the injured joint is frequently or forcibly moved in the early stages; recurrent edema—reactionary traumatic edema in the early stages and recurrent gravitational edema especially in the lower limbs in the later stages; infection near the joint—Inflammatory sero-fibrinous exudation spreading from a neighboring focus of infection; foreign bodies especially skeletal traction pins close to joints and repeated passive stretching and forcible manipulation of a stiffened joint—traumatic sero-fibrinous exudation from the stretched and torn adhesions.

In the chapter on fractures of the bodies of the dorsolumbar vertebrae a well illustrated description is given of the application of a plaster jacket. With the use of the plaster jacket Watson-Jones advocates exercises for the spinal and the abdominal muscles throughout the period of immobilization. He emphasizes that the sooner a man is dispossessed of the idea that "his back is broken" and that "he will never walk again" the more certainly will functional disturbances be avoided.

In the chapter on injuries of the knee he has stated: "Redevelop the quadriceps. Exercise for

five minutes hourly throughout the day." It is shown that the wasting of the quadriceps muscles is in itself a source of disability. The knee-joint is imperfectly protected from the twists and strains of weight bearing. Repeated stretching of ligaments and nipping of synovial fringes cause recurrent effusion and the swelling may persist for many months. The author in all his discussions on exercises emphasizes that it is not enough to advise the patient vaguely to practice exercise. Specific instruction is essential.

The foregoing examples and the many other references to the importance of active exercise in the treatment of fractures and of joint injuries make this a book that should be in the library of every physical therapy department. It can be highly recommended to every physician treating fractures.

**AN ATLAS OF HUMAN ANATOMY FOR STUDENTS AND PHYSICIANS.** By *Carl Toldt*, M.D., Assisted by Professor *Alois Dalla Rosa*, M.D., Adapted to English and American International Terminology by *M. Eden Paul*, M.D. Brux., M.R.C.S., L.R.C.P. Second Edition. Cloth. Volume I, Pp. 462 with 640 illustrations; Volume II, Pp. 1057 with 865 illustrations. Price \$10.00. New York: The Macmillan Company, 1941.

The first volume of this atlas considers osteology, arthrology and myology. Volume two considers splanchnology, angiography, neurology and the organs of the senses. The first volume describes by illustrations the microscopic structure of bone and a detailed description of each bone of the axial skeleton, the skull and the upper and the lower extremities. In the next section the various types of articulations are illustrated, then the articulations of the trunk, head and extremities. Part three of this volume illustrates the elementary constituents and structure of muscle, the principal muscular forms, the relation of the muscles to the joints and the aponeurosis or fascia. There follow many good illustrations of the origin, insertions and relations of the muscles of the trunk, head and neck, of the upper extremity and the lower extremity. The volume should be in the library of every school for physical therapy technicians as a reference book for the anatomy course in anatomy. The two volumes can also be recommended to medical students.

**PHYSICIAN'S HANDBOOK.** By *John Warkentin*, Ph.D., and *Jack Lange*, B.S., M.D. Second Edition. Pp. 281. Paper. Price, \$1.50. Chicago: University Medical Publishers, 1942.

That this excellent handbook has filled a definite need is evidenced by the fact that the first edition received such a reception that a second edition was soon found to be essential. Part one deals with laboratory diagnosis and this section has been completely revised. Of special interest are the serodiagnostic methods which include skin tests and hypersensitivity. Part two gives the pertinent facts of clinical procedures. The sections dealing with clinical history outlines (new), electrocardiography, surgery pre- and postoperative care, fluid adminis-

tration (new), the Wilder test for Addison's disease, diabetes, and the physiology of hormones, are especially to be commended. In addition there are important tables on blood typing, types of jaundice, functions of spinal roots, vitamins and sulfonamide drugs. The handbook is well printed and small enough for the pocket; and it contains information that is usually difficult to secure without consulting many books. Such a compact wealth of information will be found valuable to medical students, interns, physicians and physical therapy technicians.

**THE VALUE OF HEALTH TO A CITY: Two LECTURES DELIVERED IN 1873.** By *Max Von Pettenkofer*. Translated from the German, with an introduction by *Henry E. Sigerist*. Pp. 52. Boards. Price, \$1.00. Baltimore: The Johns Hopkins Press, 1941.

There was a time seventy years ago when the death rate in the city of Munich was thirty-three per thousand and when Max Pettenkofer—the first Professor of Hygiene at the University of Munich and one of the most colorful personalities in the history of public health—wished its citizens to be as healthy and live just as long as those of London, where the death rate at that time was only twenty-two per thousand. Being invited to address the "Verein fur Volksbildung" (Society for Popular Education), he took this opportunity to embody in two lectures the arguments for the necessity of far reaching reforms for the betterment of sanitary conditions in that city. These two lectures as originally published in 1873 in pamphlet form are a splendid document of the heroic days of modern public health. In the first lecture Pettenkofer assembled evidence of the money value of health to the city by showing the average cost in money due to loss of wages and expense of medical care due to unnecessary illness, as well as loss of working time, finally the capital losses due to premature deaths. He paid high tribute to British public health which at that time had already reacted satisfactorily against the evils of industrialization. In the second lecture he developed the theme "that whoever makes Munich as healthy as London bequeathes to the city, so to say, a capital of so and so many millions." He promised no magic formula to change conditions, but drew a brilliant picture of a modern health program: a careful survey of existing conditions, intelligent planning based on scientific data and incessant, tenacious efforts to carry out the program.

It is to the credit of our own leading American medical historian, Dr. Henry E. Sigerist of Johns Hopkins University that these classics of not only medical economics, but of public health at large were accurately retranslated into English, superseding their early inaccurate translation. Dr. Sigerist wrote a stimulating introduction to the two lectures which although seventy years old contain much of pregnant interest for today. He also gives a fas-

cinating outline of Pettenkofer's vigorous personality and many sided talents, and ends up by describing the success of his efforts and his elevation to an "Honorary Citizen" of Munich. Perhaps as not to mar this glorified picture, Sigerist does not mention that Pettenkofer ended in a fit of depression by suicide at his home on the Starnberger See, the same lake in which fifteen years earlier the insane King, Louis II of Bavaria, ended in drowning together with the court physician von Gudden. Physicians, social workers and laymen alike should read Dr. Sigerist's small volume with wistful interest amidst the holocaust of today which undoes so much of the progress in public health brought about by German philosophers and scientists of a different generation.

**COMMUNITY HYGIENE.** By *Dean Franklin Smiley*, A.B., M.D., Professor of Hygiene and University Health Officer in Cornell University and *Adrian Gordon Gould*, M.D., Assistant Professor of Hygiene and Attending Physician in Cornell University. Third edition. Pp. 448, 121 figures. Price, \$2.50. New York: The Macmillan Company, 1941.

In the third edition of the volume of Smiley and Gould there is an endeavor to take cognizance of the profound changes in the field of preventive medicine. After the introductory chapter on the development of community hygiene five section headings are devoted successively to "Environmental Health Hazards and Their Control," to "The Community Attack on Specific Diseases and Disorders," to "Health Problems Specific to Certain Groups" and finally to "Health Agencies." The material is divided into twenty-five chapters and within these appear the specific presentation of the latest aspects of community hygiene, such as the newer knowledge of air-borne infection, the broader conception of weather in relation to health, the scavenger action of the soil, food deficiencies, the changing emphasis in tuberculosis from control to eradication, the re-evaluation of the medical examination in the school health program, the various effects of the Wage and Hour Act of 1938 on industrial hygiene, the newer military medical problems created by air service, bombing and mechanized warfare, our changing conceptions of what is "adequate" in hospital and medical care, the recent forms of hospital insurance and voluntary health insurance and the new sulfonamide drugs, the revised Food and Drugs Act and the expanding functions of government in the health field. Because of the vast aspects of the material detailed presentation is necessarily impossible at times. One hundred and twenty-one figures and many tables add to the instructive value of this comprehensive revision which should be received with justified satisfaction by all those interested in modern public health and its present-day synonym, preventive medicine.



# PHYSICAL THERAPY ABSTRACTS

## Sciatica. Vernon J. Hittner.

Wisconsin M. J. 40:1048 (Nov.) 1941.

Sciatica is a symptom or disease which causes considerable suffering. There has been no one satisfactory treatment, and because of the multiplicity of remedies offered it must be admitted that the ultimate goal has not been reached.

This is a brief outline of the various methods used in treating sciatica, all of which have been successful in certain cases. 1. Rest in bed on a firm mattress with a lumbar support and sometimes a plaster spica. 2. Strapping the back or use of a Taylor brace. 3. Elimination of possible etiologic factors, such as (a) Toxic foci or sources of referred pain (and this includes insulin in diabetics). (b) Correction of faulty posture by exercises (usually have lordosis). (c) Correction of flatfoot. 4. Measures to absorb local fibrosis and free adhesions, such as (a) Local heat, such as diathermy. (b) Massage. (c) Passive motions. (b) Nerve stretching, using postural and open methods, endoneurial sciatic injection, epidural intrasacral injection, or Buck's extension applied to one or both legs to relieve muscle spasm. Eight to ten pounds are used and the traction may be constant or intermittent. (e) Perineural injection and injection of the pyriformis muscle. (5) Intravenous shock therapy, such as triple typhoid for non-specific foreign protein. (6) Operative enlargement of intervertebral foramens if narrowed due to arthritic change. (7) Section of the iliobibial fascial band when due to tension of the tensor fasciae latae. (8) Separation of adhesions along nerve trunks by open operation. (9) Laminectomy with removal of protruded intervertebral disks. (10) Salicylates still remain the medicine of choice.

## Experimental Aspiration Pneumonia: Fluorescence and Pathology. Irving J. Wolman, and Anna B. Bayard.

Am. J. M. Sc. 202:542 (Oct.) 1941.

These authors conclude: 1. The pathologic reactions in rabbit lungs to the introduction of cod-liver oil, mineral oil, butter, evaporated milk, and autoclaved fat-free milk have been studied. 2. Each of these foreign substances gave rise to characteristic changes sufficiently distinctive as regards gross appearances, histologic architecture, staining reactions, and fluorescent behavior to permit accurate identification, not only of the foreign substance itself, but often, also, of the age of the lesion. 3. The pathologist when studying autopsies should attempt to make specific diagnoses such as mineral oil pneumonia, cod-liver oil pneumonia, and milk aspiration pneumonia, rather than be satisfied with the less definitive terms aspiration pneumonia or lipid pneumonia.

## Iontophoresis of Copper Sulfate in Cases of Proved Mycotic Infection. Arthur M. Greenwood, and Ethel M. Rockwood.

Arch. Dermat. & Syph. 44:800 (Nov.) 1941.

Any one who has used ion transfer in the treatment of cutaneous diseases will agree with Shaffer that the method is "complicated, technical, tedious and time consuming." If this is so, in order to justify its use its advantage over simpler methods of treatment must be demonstrated.

It is evident that under the conditions of this experiment the method was neither fungicidal nor fungistatic. There are two reasons at least why this method is ineffective: First, the assumption that copper sulfate is a fungicide for dermatophytes has never been proved. Copper and sulfur compounds are effective protectants against fungi causing diseases in plants, and because this is so it has been assumed that they are likewise effective against dermatophytes. This assumption is, the authors believe, without experimental proof. McCallan has shown that copper and sulfur compounds are effective against plant pathogens because excretions from the spores of the pathogens put into solution the toxic elements from these compounds, and these solutions produce the fungicidal and fungistatic effect. This effect, however, takes place under conditions which do not apply in any way when one is dealing with the action of these substances on dermatophytes.

A second explanation of the inefficacy of ion transfer (copper) as a fungicidal method involves a discussion of the fate of copper sulfate introduced into the skin by electrophoresis. It is probable that some of the copper is deposited on the cutaneous surface, where it combines with the proteins of the skin to form copper albuminates. An uncertain number of ions may be carried away by the blood and lymph to be deposited elsewhere in the body; the depth of penetration and the time required for penetration are unknown, but the depth is probably slight and the time required for penetration long. Turrell stated that the effects of electrophoresis are probably due to the heat generated by the electric currents rather than to the medicaments used. It is reasonable to conclude that even if copper sulfate were effective as a fungicide for dermatophytes, it would be doubtful if sufficient amounts reached the pathogens or remained in contact with them long enough or in a suitable form to be effective.

## The Cerebral Palsy Problem. Lyman C. Duryea.

New York State J. Med. 41:1819 (Sept.) 1941.

A program of home training and care should be instituted by the utilization of the services of local orthopedic and other nursing agencies. An essential part of care is the training and education

of parents in their responsibilities to the child and in the specific procedures that the parents should follow in the home to supplement the treatment and training provided the children by private physicians and clinics.

The basic personnel required for a properly established diagnosis and treatment program consists of (1) A physician experienced in the diagnosis and treatment of cerebral palsy. (2) A psychologist with special experience in examining children with cerebral palsy. (3) A chief physical therapist trained and experienced in the treatment of cerebral palsy and capable of training others. (4) An assistant physical therapist with similar qualifications. (5) Teachers experienced in teaching children with cerebral palsy.

This personnel should be utilized to provide to others training and education in diagnosis and treatment of cerebral palsy and in the special technics required. Research should be encouraged.

#### The Influence of Glycine on Muscular Strength. S. M. Horvath; C. A. Knehr, and D. B. Dill.

Am. J. Physiol. 134:469 (Oct. 1) 1941.

Down the centuries one mark of man's prowess has been great muscular strength, and any means of increasing it has been as much sought for as the philosopher's stone. One of the most recent expedients is the addition of glycine to the diet (Chaiklis, 1941). If this does increase muscular strength, the increase would appear to be implicit in the reported role of gelatin, which is one-quarter glycine, in increasing work capacity on the bicycle ergometer (Ray et al., 1939). Possibly glycine, whether ingested as such or as a constituent amino acid in gelatin, has a creatinogenic action. If so, its reputed action in exercise might find an explanation, as well as its effect on muscular dystrophies (Boothby, 1934).

Eight subjects were tested for strength of grip twice daily for eleven weeks. Four subjects received daily six Gr. of glycine for eight weeks. Two received it for four weeks and then received placebos. Two others served as controls for nine weeks. One of these was then given twelve Gm. of glycine daily for two weeks.

The improvement in grip strength in subjects receiving glycine was no greater than that of those who were given placebos. Neither creatinine nor creatine excretion showed changes attributable to the ingestion of glycine.

#### Probable Arterial Embolism of Legs. Queries and Minor Notes.

Abst. J. A. M. A. 117:977 (Sept. 13) 1941.

*To the Editor:* — A woman aged 56 has chronic cholecystitis and auricular fibrillation, both of several years' duration. She takes 1½ grains (0.1 Gm.) of digitalis every night before going to bed and a recent electrocardiogram showed moderate effect of the digitalis. In personality, she is nervous but active. Her blood pressure is 170 systolic and 110 diastolic. One night she was unable to sleep, and after several hours in bed she suddenly suffered a severe pain in the right toe and then

in the left toe, and then both legs became painful up to the knees. Observation of the extremities by members of her family showed that both lower extremities were blanched, while she was in agony from the excruciating pain. I arrived about one hour after it started, after she had taken ½ grain (0.03 Gm.) of codeine with 3 grains (0.2 Gm.) of acetylsalicylic acid and after the extremities had been given a brisk massage. Color was returning at that time and she felt intense numbness and a tingling sensation. Another ½ grain of codeine was given, and 2 cc. of caffeine with sodium benzoate was injected intramuscularly. In about half an hour she felt well again. The next morning she bathed her feet in water which to her was tepid but to her assistant was hot, but she had no pains. I felt the pulsation of the dorsalis pedis when I saw her that night. She had had a similar but more severe attack the previous year but none since then. Can you tell me whether this is a form of Raynaud's disease in spite of the fact that the upper extremity has never been involved? Can you suggest a better diagnosis and treatment? Although there has been a year's interval between attacks, I should like an explanation of the phenomenon.

M.D., Connecticut.

*Answer* — Raynaud's disease is a definite syndrome characterized by intermittent episodes of discoloration, limited almost entirely to the fingers or toes. When it is fully developed, the syndrome is characterized by pallor and followed by cyanosis and then by rubor. Such episodes of discoloration are almost always induced by exposure to cold, but occasionally they occur as a result of emotional strain. In the early stages the digits assume normal color within a few minutes after the nervous strain has been relieved or the extremities have been exposed to warmth instead of to cold. Raynaud's disease is almost never associated with pain, although numbness and awkwardness of the extremities are frequently associated with the pallor and cyanosis, and tingling is frequently associated with the stage of redness. It seems certain that the patient whose history is outlined does not have Raynaud's disease. The history is suggestive of sudden arterial occlusion associated with severe secondary spasm of the main arteries of the lower extremities. It is probably that as a result of the auricular fibrillation there are thrombi on the walls of the auricles of the heart, parts of which become detached at times to form emboli to the lower extremities. Such an event would explain the blanching of the skin and the severe pain. The disappearance of pain, the return of normal color to the skin and the return of pulsations in the peripheral arteries in the case of arterial embolism is apparently due to relaxation of the arterial spasm which results from the lodging of the embolus in the peripheral arteries. The problem in this case is the prevention of embolism, and the advisability of restoration of normal cardiac rhythm by using quinidine sulfate should be considered.

There are three important "don'ts" in the treatment of sudden arterial occlusion: Don't delay treatment for more than two or three hours, don't elevate the extremity and don't subject it to heat which exceeds by more than a few degrees the temperature of the body. Delayed treatment means a poor prospect of recovery in those instances in which recovery would not occur spontaneously. Until the custom disappears entirely it cannot be emphasized too frequently that tissue deprived of its normal blood supply does not tolerate heat well. Hot water bottles are frequently of a temperature which exceeds 150 F. and will almost invariably provoke burns if allowed to come in contact with the skin. It is believed that recovery would have occurred in many cases if burns had not resulted from hot water bottles.

Continuous intravenous infusion of appropriate amounts of heparin may be begun at once. The time for coagulation of the blood should be kept as nearly as possible at three times normal. This serves to prevent extension of thrombosis and to prevent the thrombosis which may occur after operation if embolectomy is performed. Treatment with heparin should be continued until recovery or until gangrene is inevitable. If successful operation is performed, treatment with heparin should be continued for several days.

Opiates should be given immediately to control pain as in myocardial infarction. The ingestion of alcoholic drinks may be of benefit, apparently because alcohol is an antispasmodic as well as an anodyne. The extremity should be wrapped in cotton, which can be held in place with a roller bandage to preserve the natural warmth of the extremity. A cradle, open at one end and containing not more than one or two bulbs, may be placed over the extremity. The temperature of the air about the limb should not exceed 105 F. The extremity should be placed in a dependent position. When the legs are involved, the head of the bed should be elevated; when the arms are involved, the patient should be in the semi-sitting position. Vasodilators should be given to relieve arterial spasm, if present. Papaverine hydrochloride, which is a vasodilator when given intravenously or into the artery proximal to the area of occlusion, in amounts of 0.032 Gm. will produce improvement in the circulation of the limb within a few minutes if it is effective at all. Care should be taken that the solution of papaverine hydrochloride is physiologically active. If the first injection does not cause improvement, it is questionable that further trial with this drug will benefit the circulation. If improvement follows use of papaverine, the injection can be repeated whenever there is evidence of failing circulation to the extremity. The temperature of the environmental air, that is, the room temperature, should be kept at about 90 F. Hot packs may be applied continuously to an extremity not involved or to the involved extremity proximal to the embolus, as both procedures should produce vasodilatation. Intermittent venous occlusion may help. An ordinary sphygmomanometer cuff placed well proximal to the site of occlusion

may be alternately inflated to diastolic blood pressure and deflated at two minute intervals for several hours. The Sanders oscillating bed, which performs postural exercises for the patient, may help, particularly if treatment is carried out in a warm room. Short wave diathermy may produce vasodilatation. Electromagnetic induction by means of a cable arranged in a pancake formation over the lumbosacral area is a superior method.

**Prognosis in Bilateral Renal Tuberculosis.** William F. Braasch, and Edmund B. Sutton.

*Canad. M. A. J.* 45:320 (Oct.) 1941.

A diagnosis of bilateral renal tuberculosis was made in 291 cases, or 13 per cent, of 2,200 cases of renal tuberculosis observed at the Mayo Clinic during the years 1910 to 1934. Eighty-seven of these patients were subjected to nephrectomy, leaving 204 cases of bilateral tuberculosis for which operation was not done.

The subsequent clinical course was traced in 167 cases with definite clinical evidence of bilateral renal tuberculosis.

The survival of patients traced after three years or more was 72 per cent; after five years or more, 58 per cent; after ten years or more, 26 per cent, and after fifteen years, 16 per cent. Most of the patients alive ten or fifteen years after examination were reported as being in a fairly normal condition, except for a variable degree of frequent urination.

Therapeutic measures, such as sanitarium treatment or the advantages of rest, diet and sunshine, undoubtedly are factors in aiding longevity.

Our previous concepts concerning life expectancy with non-surgical renal tuberculosis demand radical revision. Unless the indications for nephrectomy are quite definite in a case with bilateral disease, it would be well to give nature a chance.

**Traumatic Edema of Hand.** Schörcher.

*Beitr. z. klin. Chir.* 171:176 (June 12) 1940.

According to Schörcher, traumatic edema of the hand develops as a rule a few hours after a slight dull injury to the hand. The back of the hand swells, and the thenar and hypothenar eminences and other soft parts of the hand become involved. The cutaneous rugae disappear; the skin becomes shiny and bluish pale and feels much cooler than the opposite hand. The swelling does not pit on pressure. Sweating may be increased or decreased. Motility of the fingers is restricted, so that making a fist is impossible. The hand is painful and hypersensitive to cold. The grave course of the disorder contrasts strongly with mildness of the injury. Operation offers the only cure. The cause is unknown, but from the effectiveness of surgical intervention on the nervous system it has been surmised that a constitutional inferiority of the neurovascular system is responsible. The author reports the history of a patient who developed edema of the right hand following a street car accident.

Externally no injury was visible, but the hand became painful and two hours later presented an elastic swelling. Poultices, ointments, hot air, massage, exercises and roentgen treatment persisted in for ten weeks proved of no avail. Intervention on the sympathetic nervous system was decided on next. Several cubic centimeters of a 0.2 per cent solution of pontocaine hydrochloride was injected into the right stellate ganglion. This reduced the swelling of the hand but also produced Horner's syndrome. The swelling and pain recurred six days later. Anesthesia of the stellate ganglion was repeated with the same result, except that the improvement lasted only two days. Next, the stellate ganglion was resected, resulting in the disappearance of the swelling, which, however, recurred seven weeks later. A periarterial sympathectomy was now performed on the recurrent ulnar artery. The edema disappeared within thirty-six hours but reappeared four days later. Periarterial sympathectomy was then performed on the ulnar artery at the wrist. Four weeks later the woman worked again as a milliner, but the edema recurred and local anesthesia was induced in the ulnar nerve at the elbow. The swelling subsided on the ulnar side of the hand. Three weeks later a silk thread drainage was introduced, and this controlled the swelling and pain after two weeks. The patient has since worked for eight months without further trouble. In the type of traumatic edema under discussion, the tissues show no inflammatory changes. Traumatic edema of the hand has been explained in various ways. The author is opposed to the assumption that the anatomic structure of the fascia of the hand is responsible. Those who regard traumatic edema of the hand as a reflex neurosis consider only the blood vessels to the exclusion of lymph vessels. The author argues that the lymphatic system must likewise have a sympathetic innervation and shows that in edema of the hand the pathologically increased peripheral sympathetic reflexes act not only on the blood vessels but on the lymph vessels as well. The fact that the silk thread drainage counteracted the edema is additional proof that the condition is due not only to the impairment of the capillaries but to that of the lymph vessels as well. — (Abst. J. A. M. A. 117:899 [Sept. 8] 1941.)

#### Counter-Irritation in the Treatment of Rheumatism. Zikmund Winter.

Clin. J. 70:290 (Nov.) 1941.

The late Dr. Jetel, of Prague, introduced a successful treatment for sciatica based on skin irritation with etheric oils. His ointment is as follows: Linseed oil 100.0, euphorbia 5.0. Boil for an hour. Allow to stand for forty-eight hours to allow the oil to clarify, then filter. Of this filtrated oil take 7.5, mix it with 25.0 of lard. Add croton oil 2.0, yellow wax 1.0, ethereal cinnamon oil 2 drops. Mix to make an ointment.

This ointment is rubbed once daily along the course of the sciatic nerve until vesicles and pustules result. The cantharidin plaster has also a blister-raising effect, but in order to prolong

the irritative stimulation a bandage of 10 per cent, ungt. mezerei should be applied for one or two days after removal of the plasters. In the treatment of fibrosis the author uses 2 to 6 per cent solution of croton oil in ol. pini or terebinthinae with excellent results. Another excellent vesicant is: Croton oil 2, chloroform 80, camphor spirit 80, menthol 1. The skin reacts energetically to croton oil, and after few applications a rash with blister formation appears. The author observed that the long lasting effects of skin irritation were followed by better results than after a transient rush. Ion transfer (histamin) and ointments containing bee poison have only a fugitive action on the skin: the rash induced disappears in a few hours. Therefore in the treatment of rheumatism they have only a subordinate value. In stubborn chronic cases of sciatica which do not respond to physical treatment, good results are obtained by intensive and long-lasting (a few days) vesicle or pustular formation. The continuous flushing of the skin apparently brings about a great reflex vasodilatation in the corresponding deep tissues. The same good results were obtained in cases of muscular fibrosis.

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#### Cold Allergy: Report of an Unusual Case. Wallace M. Yater, and Edward W. Nicklas.

Ann. Int. Med. 15:743 (Oct.) 1941.

Cold allergy has been known since 1866, when Bourden described urticaria and syncope due apparently to cold. However, in 1872 Blachez gave the first classical description of urticaria from cold. Since then several other writers have reported cases of this form of allergy. Since 1924 Duke has written voluminously on this subject, describing various forms of physical allergy, which he found to be not uncommon. He suggested the possibility that a histamine-like substance might be liberated locally and be responsible in some instances. Lewis later showed the probable existence of such a substance. In 1929 Horton and Brown reported a study of 6 cases of cold allergy in which attacks of syncope resulted from exposure of the skin to cold. They showed that if a tourniquet were applied to an extremity proximal to the chilled area the reaction would not occur. In 1936 Horton, Brown and Roth published an outstanding contribution to the subject.

These authors report a case of cold allergy associated with purpura hemorrhagica of the affected, mainly acral, parts. The earlier urticarial reactions gradually subsided, leaving the purpuric manifestations of the ears, hands and feet as the outstanding feature of the case. There were no general or constitutional reactions on exposure to cold. At least two episodes are recorded, however, of hemorrhagic renal lesions which probably were purpuric in nature. No blood dyscrasia could be demonstrated. In spite of the definite cold allergy disclosed, there was not therapeutic response to the usual methods employed and found to be satisfactory in other cases of cold allergy. Apparently beginning as a simple cold allergy

the condition finally became one of persistent purpura hemorrhagica of the acral parts with the evidence of cold allergy still persisting in the form of urticaria that could be induced locally by the application of cold objects to the skin. A similar case has not been previously reported.

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**Electric Shock Therapy in Mental Disease. A. Myerson.**

New England J. M. 224:108 (June 26) 1941.

Myerson employed electric shock therapy in the treatment of 36 patients with affective psychotic disturbances. The diagnosis was depression or depressed obsessive state in 24, was schizophrenia in 9 and chronic neurosis in 3. The average number of shocks, lasting from thirty to forty-five seconds, was between five and six. For most patients a voltage of 70 with a milliamperage of from 350 to 500 delivered for one-tenth second was sufficient to produce convulsive reactions. If the dose selected is insufficient, from ten to fifteen minutes should elapse before another is given, as tissue resistance diminishes after a treatment and returns to normal only after such an interval. Of the 24 patients with depression or depressed obsessive states, all but 3 showed moderate to well defined improvement or had remissions following electric shock. None of the 9 with schizophrenia treated were significantly improved so far as the essentials of the disease process are concerned. The conduct of 3 improved. Delusions became less conspicuous. However, the retreat and the ability to meet the situations of life were only transitorily changed for the better. One of the 3 chronically neurotic patients was unwilling to continue treatment after two shocks, because of the unpleasant transient failure of memory. The other 2 patients are still under treatment with results that are doubtful. They had resisted other forms of treatment.—(Abstr. J. A. M. A. 117: 1045 [Sept. 20] 1941.)

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**Physical Therapy in the Treatment of Dermatoses Due to Pyogenic Organisms. Henry D. Niles.**

Med. Record 154:141 (Aug. 20) 1941.

There are few skin diseases in which ultraviolet irradiation is as effective as roentgen rays and not many in which ultraviolet is of more than temporary benefit. In office practice most dermatologists use a mercury quartz vapor air-cooled lamp, but as good therapeutic results can be obtained with the cold quartz or carbon arc lamps. The radiation from the latter most closely simulates that of the sun. The rays from the cold quartz lamp cause erythema and desquamation, but no pigmentation or blistering. In some conditions this is desirable, but in others it is not, so that their use is somewhat limited.

Ultraviolet irradiation is indicated in acne vulgaris only under the following conditions: in mild superficial eruptions; in patients in whom roentgenotherapy is contraindicated because of their extreme youth or because they have already been treated with as much roentgen rays as can be

given safely; in those who refuse roentgen therapy; or as a final treatment after completion of a course of roentgen rays. Ultraviolet irradiation, either from the sun or from artificial sources, will for a time benefit most cases of acne, but the effect is too superficial, to be permanent and it should never be relied on alone without the concomitant use of external and internal measures.

An exception to the general rule occurs in rosacea in many cases of which, especially the erythematous and telangiectatic forms, ultraviolet irradiation in conjunction with topical and internal remedies is often more effective than roentgenotherapy. In some cases, the course of impetigo may be shortened by a few mild erythema doses of ultraviolet, but this procedure is rarely necessary to effect a cure.

Ultraviolet irradiation is a satisfactory method of treating cryspelias. It is necessary to employ extremely large doses (eight to ten times the erythema dose) and to expose an area of normal skin for about two inches around the involved area. As the drugs of the sulfanilamide group are photosensitizing it is obvious that they should not be prescribed for patients who are having ultraviolet light therapy.

Although the various forms of high frequency current are often used and are of great value in the practice of dermatology, with the exception of rhinophyma and granuloma pyogenicum, they are not indicated in this group of dermatoses. Small nodules in rhinophyma can be destroyed by electrodesiccation or electrocoagulation and large lobules removed by the endotherm knife, with a minimum amount of bleeding and an excellent final cosmetic result. Pyogenic granulomas can be completely and permanently destroyed with very little, if any, final scarring by electrodesiccation, electrocoagulation or the endotherm knife. The chief advantage of electrotherapy over surgical excision of these extremely vascular lesions is that the electric current seals the blood vessels and prevents the bleeding which at times is very profuse during surgical excision.

Electrolysis is used to obliterate the dilated blood vessels in rosacea, especially those on the sides of the nose. Although endotherapy is usually preferable, the galvanic current may be used to destroy a very small and early granuloma pyogenicum.

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**Muscle Behavior Following Infantile Paralysis. Herbert E. Hipp.**

Am. J. Surg. 53:314 (Aug.) 1941.

Muscles long paralyzed that were treated by rest in a relaxed position for six to twelve weeks lost strength much more often than they gained.

Muscles that graded zero, trace and poor and had been paralyzed as long as three months showed no appreciable gain on the use of physical therapy.

Muscles that graded poor plus, fair, and good showed a considerable and justifiable improvement following physical therapy.

The age group six to sixteen years showed a greater improvement than younger or older groups.

Patients who received early careful physical therapy showed much better muscular recovery than those treated otherwise.

**Laryngeal Tuberculosis With Some of the More Recent Advances in Treatment. Frank R. Spencer.**

*Ann. Otol., Rhin. & Laryng.* 50:735 (Sept.) 1941.

The chemical, actinic or ultraviolet rays of the sun are the tanning rays and do much to improve the general health of the tuberculous patient. In cities or climates where the sun's rays are not available the Verba laryngoscope will reflect the actinic rays into the larynx. The mirrors are made of an alloy of aluminum and magnesium so that they will not absorb the chemical rays. The patient must be out of doors, because glass or even dusty screen will absorb the ultraviolet rays. The larynx should be exposed to the rays for one-half to one minute daily the first week and the time gradually lengthened to not exceed ten minutes for most patients. Most people believe if a little is good more will be better and they use too much. The larynx is more easily sunburned than the skin. The tolerance and the maximum dose vary greatly with different patients. The laryngologist must direct the treatment. He can do this only by studying the patient and watching the larynx. Rules are only relative.

Grain in 1936 and Cotton-Cornwall in 1938 recommended ion transfer for the relief of pain in tuberculous laryngitis. Grain encircles the larynx with special electrodes, employing a galvanic current of 10-12 ma. for thirty to forty minutes. The positive pole is wet with water and placed on the back of the neck. The anterior or negative pole is placed over the larynx and is wet with a 2 per cent solution of potassium iodide. The electrodes are protected by layers of absorbent cotton which extend beyond the edges of the treatment area. These treatments are given daily until the anesthesia lasts twenty-four hours. After this they are repeated only when the pain returns. There is a feeling of constriction in the neck according to Grain and a taste of copper on the tongue. The former lasts only four or five minutes, and the latter throughout the treatment.

The anesthesia begins early and is total according to Grain. It is progressive and lasts longer after each treatment. He believes it is not influenced by the size of the lesion and is stable. It has no value as a cure, as it only relieves the pain. The tactile sensation in the

larynx is not disturbed, so that food does not enter the larynx.

**The Legal Responsibility of the Physician. With Special Reference to Physical Therapy. Joseph Rubacky.**

*J. M. Soc. New Jersey* 38:441 (Sept.) 1941.

The author gives the following rules for those using physical therapy equipment:

1. Secure thorough didactic and practical knowledge of your specialty.
2. Select reliable apparatus and equipment.
3. Keep these in good mechanical condition.
4. Examine carefully and thoroughly the patient or the part of the body to be treated.
5. Select the correct modality.
6. Employ qualified assistants or technicians.
7. Assure proper application of current or other physical agents to diseased or injured areas.
8. Maintain constant supervision of treatment recommended to determine tolerance and susceptibility.
9. Advise patient to report immediately any pain distress, discomfort or unexpected heat or pricking sensation.
10. Reexamine (a) area treated for local reactions or (b) patient for abnormal systemic reactions.

Aside from the purpose of case history, it is essential to keep and to maintain accurate and complete records for future protection and security.

**Reactions After Ultraviolet Irradiation. A. Eidinow.**

*Lancet* 1:540 (April 26) 1941.

Eidinow studied local reactions and specific immunity response when a standard quantity of antigen (hay pollen toxin or T. A. B. vaccine) was injected intradermally into the areas of normal skin of 14 patients and their skin was irradiated with ultraviolet rays. He observed that exposure of the skin to ultraviolet radiation diminishes the local reaction normally produced in allergic patients by scarification and the application of hay pollen toxin. Intradermal injections of hay pollen toxin into an area of irradiated and erythematous skin of allergic patients excites violent symptoms and signs of hay fever or asthma with collapse. Intradermal injections of T. A. B. vaccine into areas of skin rendered erythematous by ultraviolet rays will provoke an agglutinin (H and O groups) titer in the blood serum more than ten times as great as a similar intradermal injection into areas of normal skin. The erythema reaction following exposure of the skin to ultraviolet rays may thus be used to increase local and general immunity. — (Abst. *J. A. M. A.* 117: 567 [Aug. 16] 1941.)

